




STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

February 24, 2005

MEMORANDUM TO: Roadway Design Manual Holders

FROM: Rodger Rochelle, P. E. 
State Alternate Delivery Systems Engineer

SUBJECT: Revised and New Guidelines for the
Roadway Design Manual

The following are The Revisions and New Guidelines to Part I and Part II of the Roadway Design Manual. Please insert these Revisions in your Manual in the appropriate place. These Revisions are to become effective immediately. The 2002 Roadway Design Manual on the web site has already been updated.

REVISION NO. 3

Part I – Roadway Design Manual

1. Chapter 1 – Placement of Utility Poles in Curb and Gutter Sections

NOTE: Clarification of utility pole placement as defined by the 2002 Roadway Design Guide.

2. Chapter 1 – Section 6-J Median Crossover Guidelines

NOTE: Urban and Rural are terms no longer used, also changes pertaining to posted speed as opposed to Design Speed.

4. Chapter 1 – Section 4-P Guidelines for Rumble Strips for Paved Shoulders

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NOTE: The Update emphasizes the actual placement of Rumble Strips.

5. Chapter 1 – Section 4-B Usable and Graded Shoulders

NOTE: The use of 6 foot Shoulders rather than 5 foot where environmental constraints allow.

3. Chapter 1 – Section 15 Superelevation Rates

NOTE: Changes to the Superelevation Guidelines Chart.

8. Chapter 3 – Curb and Gutter at Guard Rail Anchors Units

NOTE: Changed requirements for Curb and Gutter use.

6. Chapter 3 – Section 2-F Determining Total Guardrail Length

NOTE: Types of guardrail anchors have been updated

7. Chapter 3 – Section 6 Guardrail/ Guardrail Treatment in Median Locations Length

NOTE: Changes to special median grading.

9. Chapter 5 – Section 13 & 14-F Median Drop Inlets and Standard Catch Basins

NOTE: General Update.

10. Chapter 8 & 9 – Warrant for Turn Lanes

NOTE: Changed bay taper lengths.

11. Chapter 9 – Section 1-F At Grade intersections

NOTE: Changes to figures 1 and 2

12. Chapter 11 – Section 5-B Lump Sum Grading

NOTE: Changes to price range and how Lump Sum Grading may be used

Part II – Roadway Design Manual

13. Chapter 6 – Section 1-D Pavement Schedule – Revised 05/30/05 See Addendum

NOTE: Changes include percentage and type of Asphalt Binder Grade and Rates to be used.

If you have any questions/comments about this revision or suggestions concerning the Roadway Design Manual, Please contact Robert McKeithan (rmckeithan@dot.state.nc.us) or Pon Phongsavath (vphongsavath @dot.state.nc.us) of the Special Services Group, Project Services Unit at (919) 250-4128.

Attachment



STATE OF NORTH CAROLINA
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May 30, 2005

ADDENDUM TO REVISION NO. 3 TO THE ROADWAY DESIGN MANUAL

EFFECTIVE DATE: May 30, 2005

EXISTING SECTION AFFECTED: Part II – Chapter 6-1D – Pavement Schedule

CHANGES: B37.5C has been dropped from OPTIONS ITEM LIST.

Pavement Schedule description for D3 has been changed from 2¼" to 2½".

INSTRUCTIONS: Please insert these pages (2) to replace existing pages (2) of Part II,
Chapter 6-1D

If you have any questions, contact Frankie Draper (250-4128) of the Special Services Section, Project Services Unit.

Attachment

SHOULDERS

1-4

Paved or unpaved shoulders will be based on traffic volume warrants and the pavement composition of the adjacent pavement utilized for the mainline, ramp and etc. Figure 1-4F outlines typical paved shoulder construction. The pavement design report will specify the type of paved shoulder to construct. All utility poles shall be placed outside the Clear Zone as defined by the 2002 Roadside Design Guide.

SHOULDER WIDTHS ON MAINLINE

1-4A

See 1-4B (Figure 1) for usable and graded shoulder widths for local, collector, arterial, interstate and freeway roads.

NOTE: Due to frequent on-shoulder parking and other special design features, Subdivision Roads and Streets shall conform to NCDOT Minimum Construction Standards For Subdivision Roads and may not conform to the above design guidelines.

USABLE AND GRADED SHOULDERS

1-4B

See 1-4B (Figure 1) for usable and graded shoulder widths and their relationship to the overall shoulder width. Shoulders shall not exceed these values unless specified otherwise in the Planning Report or unless approved by the Assistant Head of Roadway Design or the Engineering Coordinator of Design Services.

NOTE: These guidelines apply to new construction, not 3-R projects.

When guardrail is required on a project, additional shoulder width, as noted in Figure 1, is needed for guardrail installation and clearance. At times, this added shoulder width is continued throughout the project for uniformity. As a cost-reduction measure, normal shoulder widths should be specified where guardrail is not required and then transitioned to wider shoulders where guardrail is required. Engineering judgement would be used in considering this method by taking into account the length of the project and the amount of guardrail required.

FIGURE 1**1-4 B****SHOULDER WIDTHS****LOCALS AND COLLECTORS**

IN THE DESIGN OF LOCALS AND COLLECTORS, USE THE FOLLOWING MINIMUM SHOULDER WIDTHS.

ADT	DESIGN YEAR			
	UNDER 400	400 - 1500	1501- 2000	OVER 2000
LOCALS AND COLLECTORS	* 2'	** 5'	6'	8'

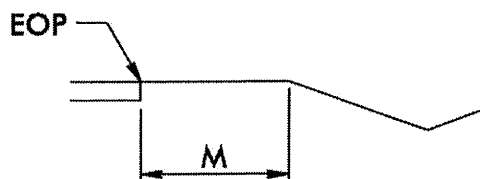
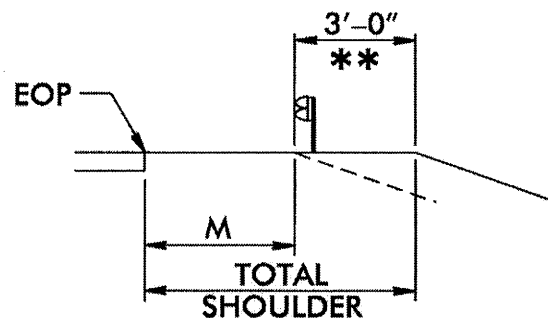
* WHEN GUARDRAIL IS WARRANTED, THE MINIMUM OFFSET FROM THE EDGE OF THE TRAVEL LANE TO THE FACE OF THE GUARDRAIL IS 4'-0".

** WHERE ENVIRONMENTAL CONSTRAINTS ALLOW, 6-FOOT SHOULDERS SHOULD BE UTILIZED RATHER THAN THE 5-FOOT SHOULDERS.

See "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS", (2001) EXHIBITS 5-5 AND 6-5.

MINIMUM SHOULDER

M = MINIMUM SHOULDER

WITHOUT GUARDRAIL**WITH GUARDRAIL**

** WHEN GUARDRAIL IS WARRANTED, THE MINIMUM SHOULDER WIDTH IS INCREASED BY 3'-0" AS SHOWN IN THE ABOVE DIAGRAM.

SHOULDER SLOPES1-4H

See Roadway Standard Drawings, Std. No's.. 560.01 and 560.02 and 1-4O, Figure 1 in this chapter.

FRONT DITCH SLOPE1-4I

The slope from the far edge of shoulder to the ditch point is commonly known as the front slope in a cut section. Front slopes shall be in accordance with Section 1-2A, Figure F-1 in this chapter.

BACK SLOPE1-4J

The slope from the ditch bottom to original ground is known as a cut slope or back slope. The back slope may be a fixed slope or a hinge point slope.

When fixed back slopes are used, they shall be in accordance with "Criteria for Roadway Typical Section and Slopes" (see Section 1-2A, Figure F-1 in this chapter). On minor or local roads, one set of fixed slopes in cuts and fills may be used for the length of the project.

HINGE POINT SLOPES1-4K

Hinge point slopes shall be used on interstate, freeway, and expressway projects. Also hinge point slopes are used on arterials, collectors, and locals (over 4000 ADT Design Year).

The primary advantage of hinge point slopes is to provide a variable slope that relates to the height of cut or fill. Also, with the utilization of variable slopes, the proposed improvements may be blended into the existing topography and provide a more pleasing appearance.

Hinge point slopes shall be used on all freeways, expressways, and interstates in all terrains except where special ditches are required, soil conditions dictate otherwise, or rock is encountered.

HINGE POINT SLOPES (continued)

1-4K

HINGE POINTS FOR FREEWAYS, EXPRESSWAYS AND INTERSTATES

See 1-2A, Figure 1(A) in this chapter. These hinges will provide a transition area at the beginning and end of cuts and fills. Steeper fixed slopes, as determined by the Soils and Foundation Section, will be utilized through the remainder of the cut or fill.

Hinge Points for Arterials

(other than Expressways, Collectors, and Locals (Over 4000 ADT Design Year Traffic))

When utilizing hinge point slopes for arterials (other than freeways, expressways and interstates), collectors, and locals (over 4000 ADT Design Year Traffic), see 1-2A, Figure 1(B) in this chapter.

VEHICLE RECOVERY AREAS

1-4L

Vehicle recovery area is defined as a traversable clear zone adjacent to the highway travel lanes within which all fixed hazards have either been removed, reconstructed to acceptable safety criteria, or shielded. The width of a recovery area varies with design speed, traffic volumes, and slope configurations.

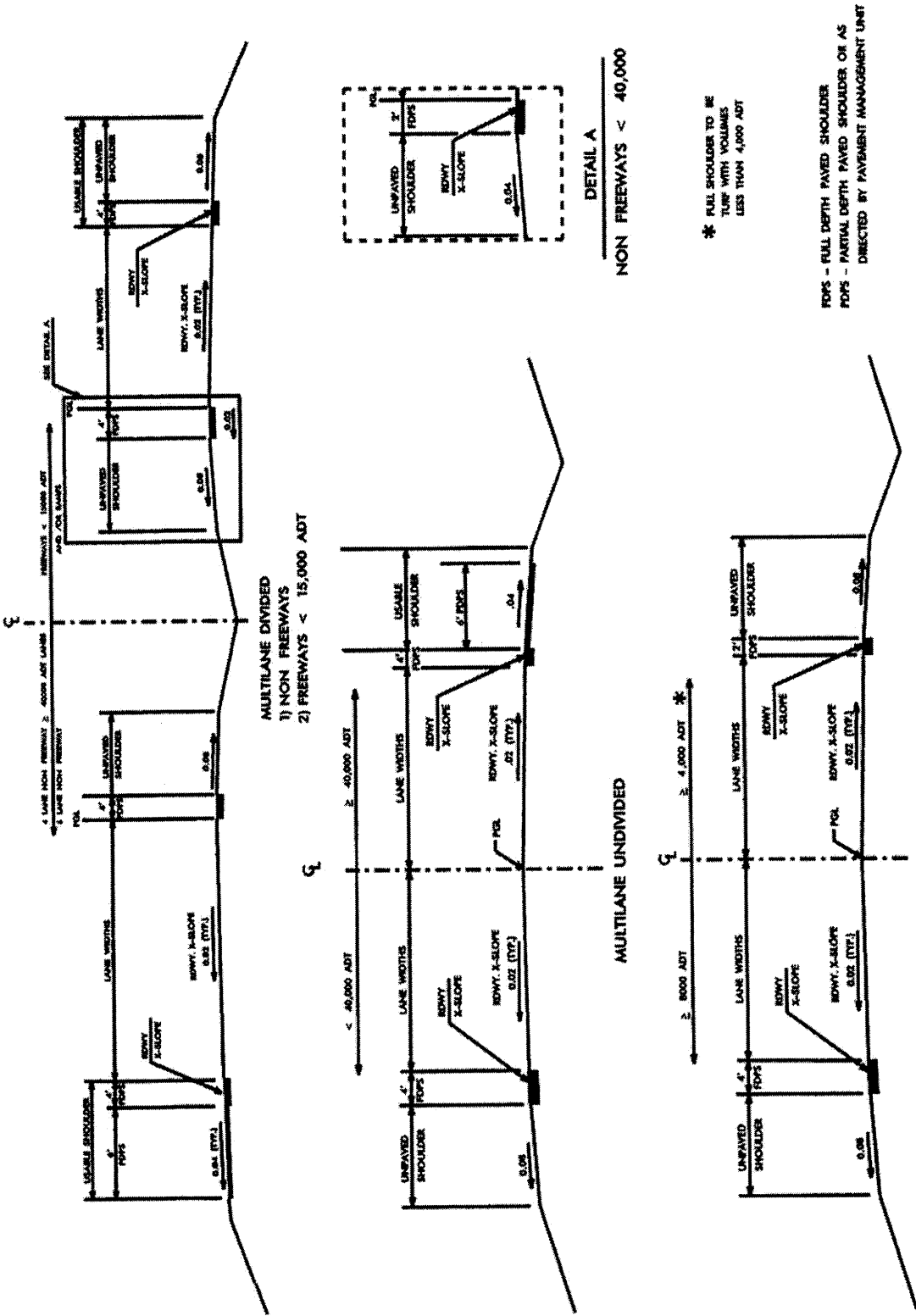
A traversable and recoverable clear zone indicate there are no slopes encountered within the clear zone which are steeper than 4:1. Slopes between 3:1 and 4:1 are traversable, but not recoverable. Any slopes steeper than 3:1 are classified as critical; an errant motorist will not be able to traverse or recover on these slopes.

For a pictorial view of the Recovery Area, please refer to 1-4M, Figure 1. Clear zone distances are shown on 1-4M, (Figures A, B, C, and D) of this Chapter.

All utility Poles shall be placed outside the Clear Zone as defined by the 2002 Roadside Design Guide. See Detail Figure 1-7D, F-4 for posted 45 PHM or less curb and gutter roadway section.

FIGURE 1

FIG - 1B



TYPICAL SHOULDER CROSS-SLOPES

**GUIDELINES FOR RUMBLE STRIPS
FOR PAVED SHOULDERS**

1-4P

The purpose of these guidelines is to provide the Highway Design Branch, Operations Branch, and Traffic Engineering and Safety Systems Branch a procedure when using paved roadway shoulders. These guidelines should be used for identifying sections of shoulders on Interstate, Freeways, Expressways and other roadway facilities where rumble strips are desirable. This policy also discusses different types of rumble strips and selection for various types and widths of paved shoulders.

Rumble strips are sensory warning treatments that are located along the paved shoulders. They alert drivers of “drifting” off the road situations by creating an audible and vibratory warning sensation that their vehicle is leaving the designated travel lane and that a steering correction is required. Rumble strips are intended to alert the motorists before they leave the roadway and strike a roadside barrier or hazard.

It is the responsibility of the State Highway Design Engineer and the State Traffic Engineer, and the Chief Engineer of Operations to ensure that the following guidelines are followed and applied consistently within their respective area of operation.

Generally, rumble strips should be used on both the **median and outside shoulder** at locations where they are required. It is not necessary to use the same type of rumble strips on the median and outside shoulders. The placement of Rumble Strips on existing roadways should be investigated to verify the shoulder width and pavement structure are sufficient. On roadway facilities designated as bike routes, the placement of Rumble Strips should be coordinated with the Bicycle and Pedestrian Division. Milled rumble strips are not recommended on structures.

Rumble strips shall be used on the following types of Median Divided Roadways:

Interstate / Freeway
Expressway (Where access is limited to at-grade intersections)

Placement of Rumble Strips**For Asphalt Paved Shoulders**

Rumble Strips will be located in accordance with the Roadway Standard Drawings, Std. No. 665.01. See details F-1 and F-2.

For Concrete Paved Shoulders

Rumble Strips will be located in accordance with Roadway Standard Drawings, Std. No. 720.01. See details F-3 through F-6.

**GUIDELINES FOR RUMBLE STRIPS
FOR PAVED SHOULDER**

1-4P

Rumble Strips should also be considered on other Roadway Facilities

- Where documented histories of lane departure type crashes exists.
- Rural median divided facilities with partial control of access (where designated driveway and street access points are allowed) should be considered on a case by case basis.

Placement of Rumble Strips on other Roadway Facilities

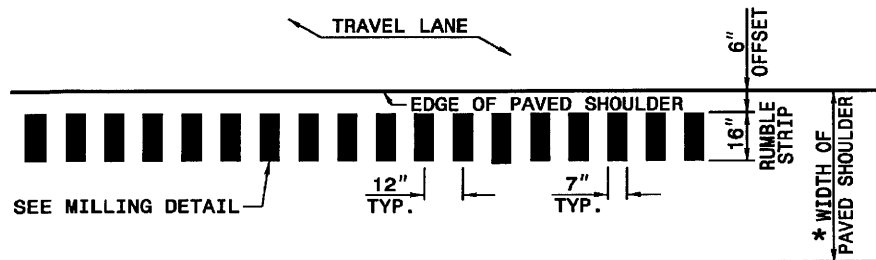
- The width of shoulder rumble strips may vary depending on the width of the paved shoulder provided. The Engineer should determine design and placement.
- The width and placement of centerline rumble strips may vary depending on lane width and pavement marking type and use. The Engineer should determine the design and placement.

Other surface treatments may be used with the approval of the State Highway Design Engineer and the State Traffic Engineer. Project Engineers from Roadway Design and Traffic Engineering should agree upon the type and extent of shoulder surface treatments, when applicable, as well as the appropriate Division Office. These guidelines are not intended to restrict or prohibit the use of any alternative surface treatment when special engineering circumstances are required. When selecting the type of treatment, consideration should be given to the potential use of the shoulder by traffic during future construction and maintenance operations.

These guidelines or the rumble strip standard drawings do not account for all possible applications. Therefore, it may be necessary for the designer to develop special application plans or details for the application of milled-in/stamped-in or alternative longitudinal rumble strip treatments. All such plans and details should be submitted and reviewed by the Traffic Engineering & Safety Branch in coordination with Highway Design Branch prior to usage on a project.

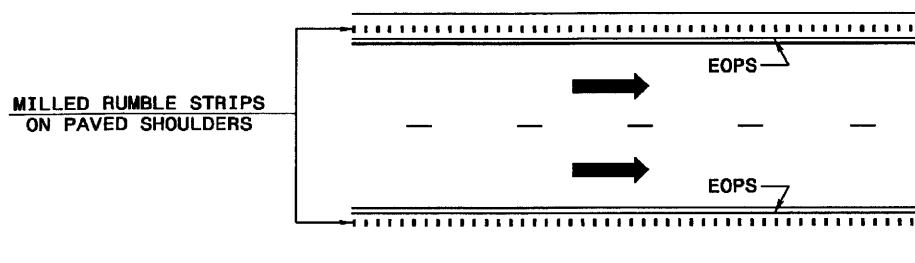
FIGURE 1**1-4P****F-1**

ASPHALT SHOULDERS MILLED RUMBLE STRIPS

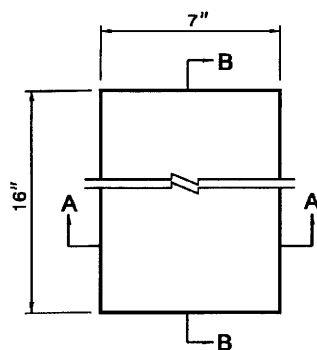


* FOR WIDTHS SEE TYPICAL SECTIONS AND PLAN SHEETS

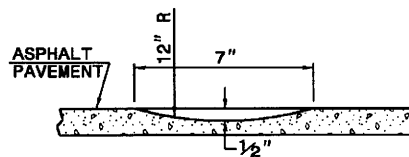
PLAN VIEW PAVED SHOULDER



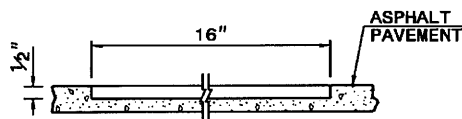
LANE TREATMENT



PLAN VIEW MILLING DETAIL



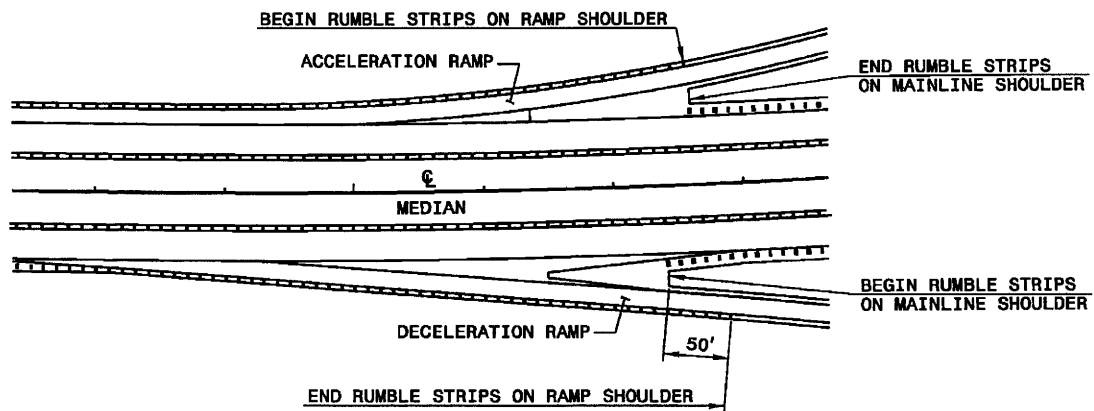
SECTION A-A



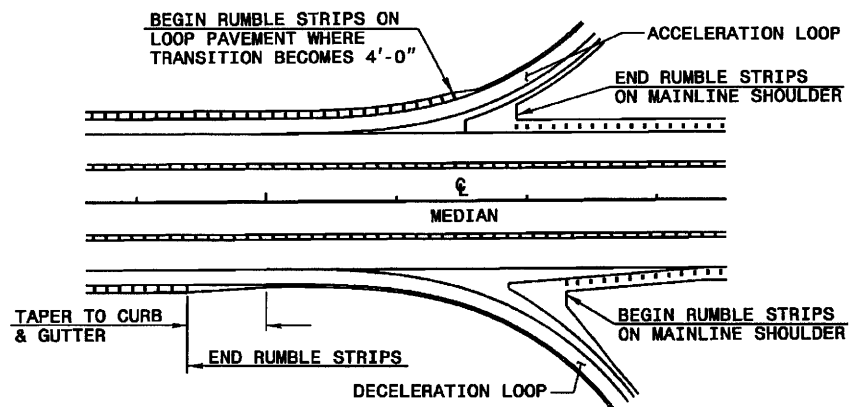
SECTION B-B

FIGURE 2**1-4P****F-2**

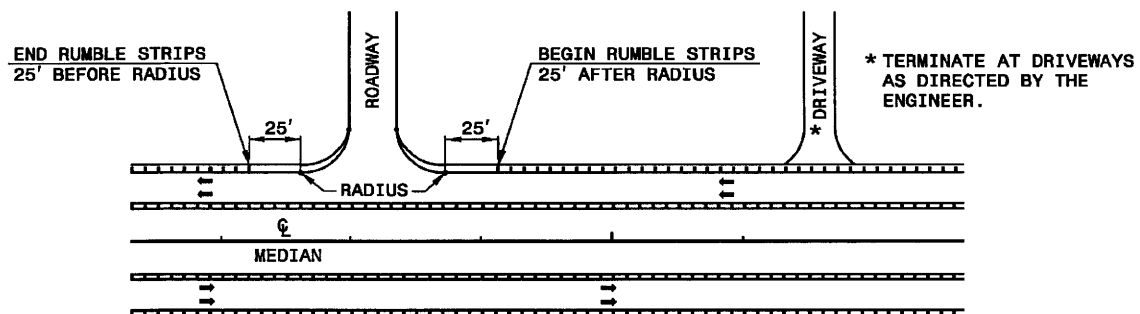
ASPHALT SHOULDERS MILLED RUMBLE STRIPS



TREATMENT AT RAMP TERMINALS



TREATMENT AT LOOP TERMINALS



TREATMENT AT INTERSECTIONS

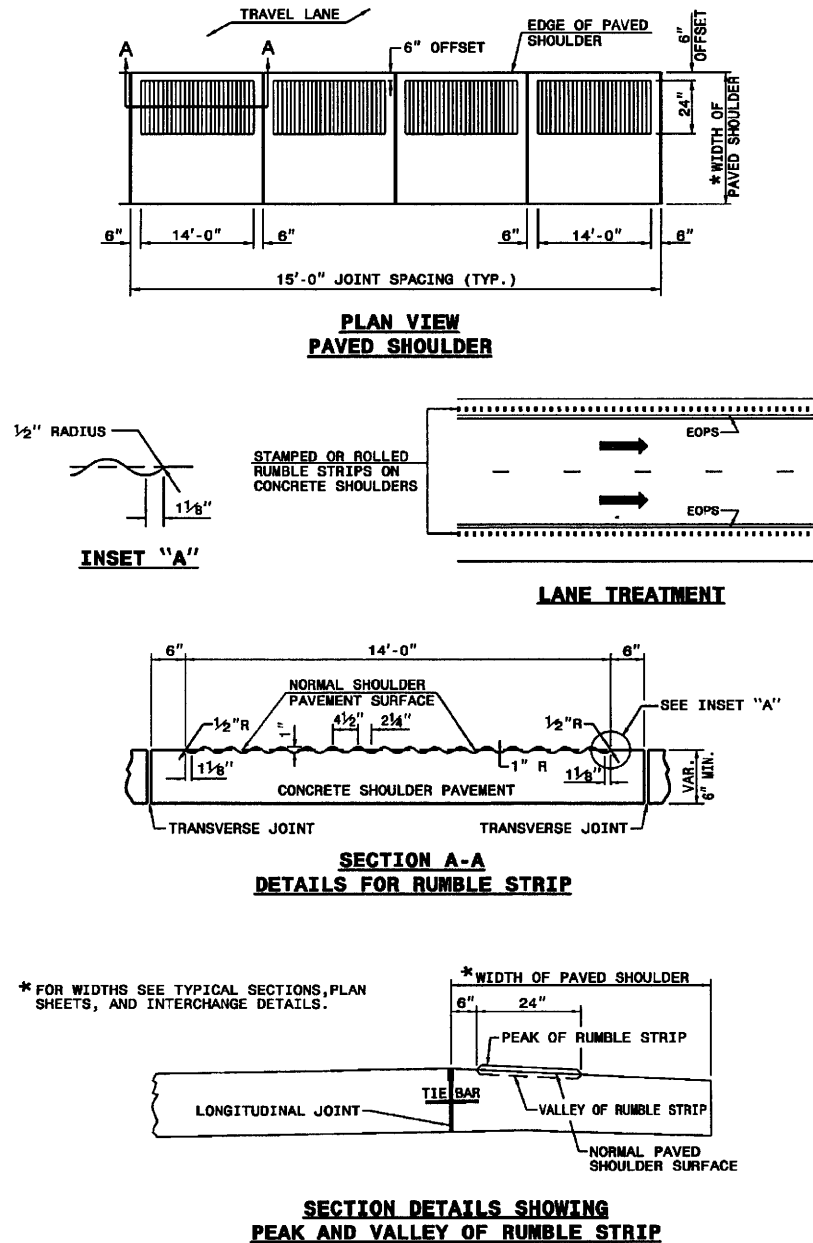
(ROADWAY OR DRIVEWAY)

FIGURE 3

1-4P

F-3

CONCRETE SHOULDERS STAMPED OR ROLLED RUMBLE STRIPS



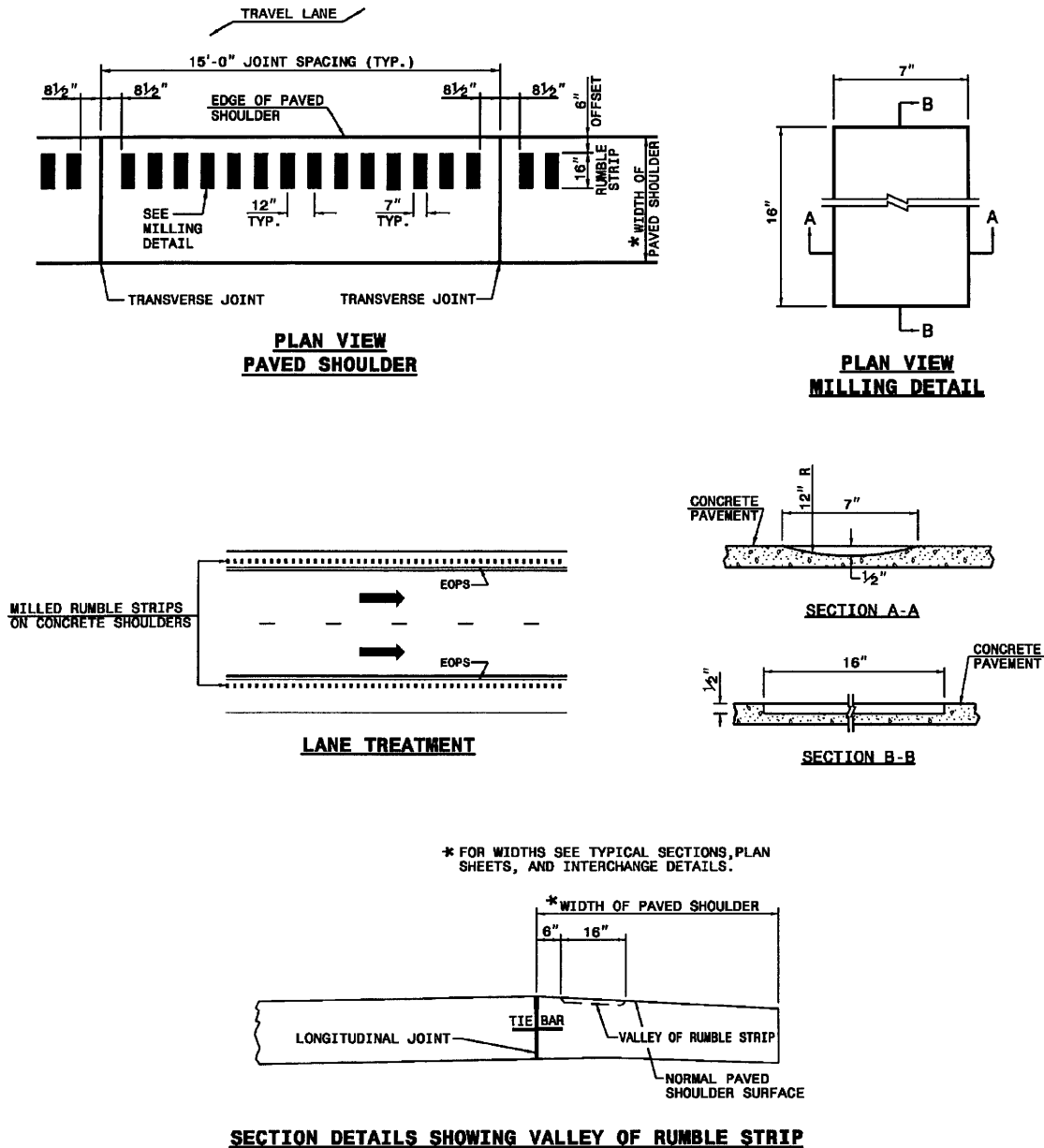
**SECTION DETAILS SHOWING
PEAK AND VALLEY OF RUMBLE STRIP**

NOTES:

1. MATCH CONCRETE SHOULDER TRANSVERSE JOINTS TO THAT OF THE ADJACENT CONCRETE PAVEMENT.
2. SAW AND SEAL THE LONGITUDINAL JOINT AND TRANSVERSE JOINTS. SEE STD. 700.01 FOR DETAILS.
3. SEE DETAIL SHOWING "METHOD OF CONCRETE SHOULDER CONSTRUCTION" FOR PAVEMENT SLOPES.

FIGURE 4**1-4P****F-4**

CONCRETE SHOULDERS MILLED RUMBLE STRIPS



SECTION DETAILS SHOWING VALLEY OF RUMBLE STRIP

NOTES:

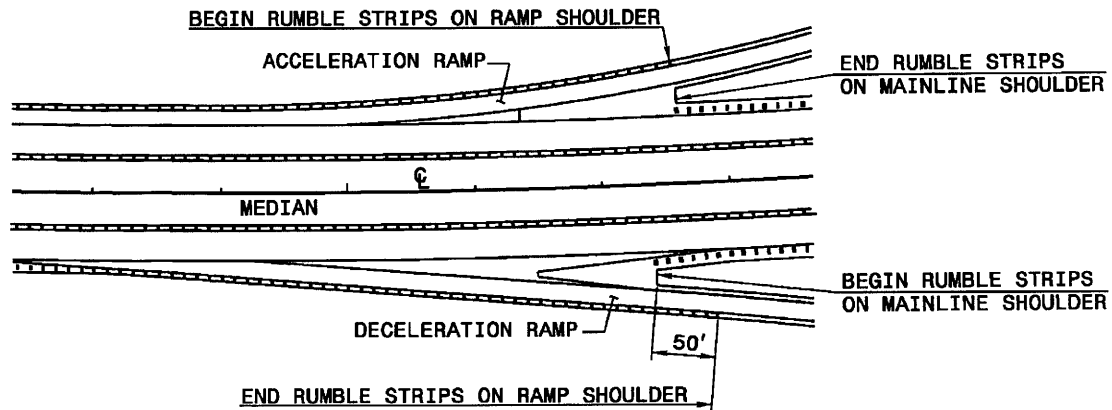
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2. SAW AND SEAL THE LONGITUDINAL JOINT AND TRANSVERSE JOINTS. SEE STD. 700.01 FOR DETAILS.
3. SEE DETAIL SHOWING "METHOD OF CONCRETE SHOULDER CONSTRUCTION" FOR PAVEMENT SLOPES.

FIGURE 5

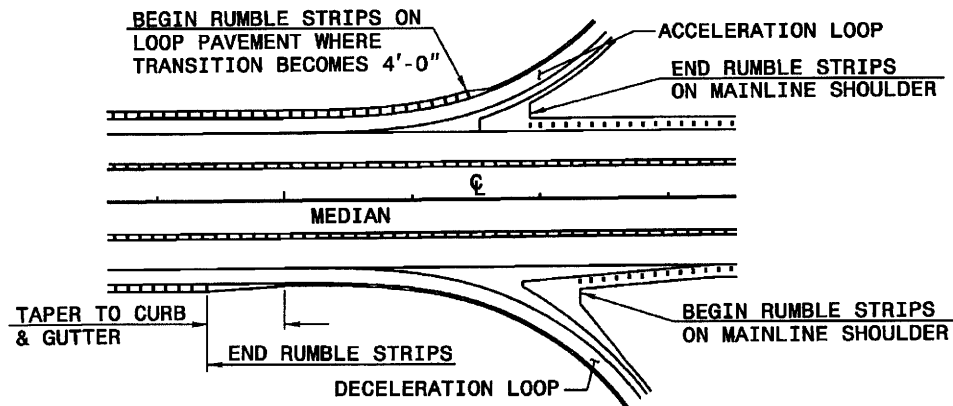
1-4P

F-5

CONCRETE SHOULDERS PLACEMENT OF RUMBLE STRIPS



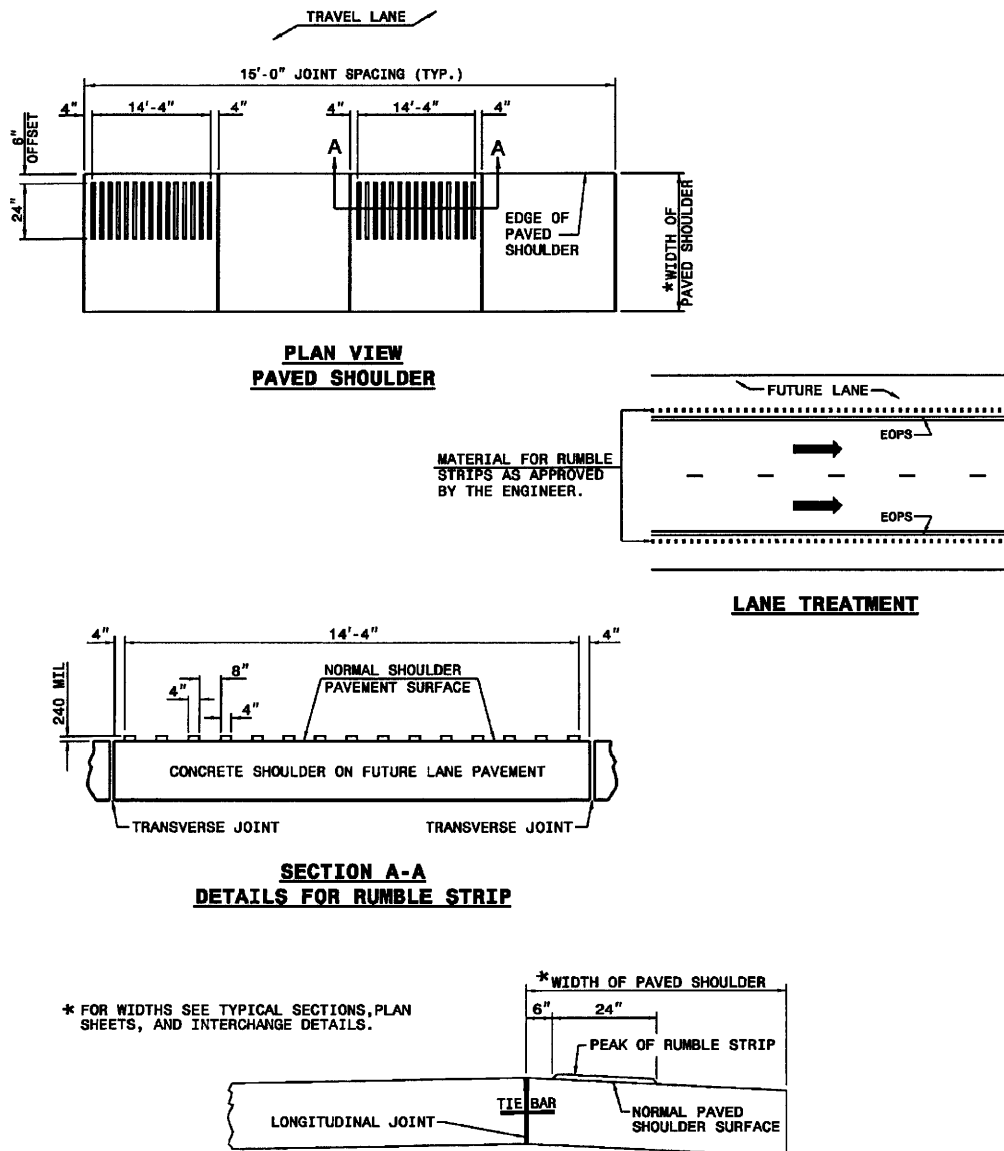
TREATMENT AT RAMP TERMINALS



TREATMENT AT LOOP TERMINALS

FIGURE 6**1-4P****F-6**

CONCRETE SHOULDERS - FUTURE LANE RUMBLE STRIPS



MEDIAN SLOPES (continued)

1-6F

- NOTE:
1. For projects with flat grades, variable median slopes that increase the ditch grade to improve longitudinal drainage capability shall be considered.
 2. Ditch slopes should meet "Roadside Design Guide" criteria for preferred ditch sections.

PROPOSED MEDIANS

(New Roadways)

When determining the width and maximum (steepest) slopes of a proposed median, consideration shall be given to the following design criteria:

A - Design Year Traffic Volume and Level of Service

B - Design Speed

C - Clear Zone Requirements "Roadside Design Guide"

D - Adequate Drainage of the Pavement Structure

When optimum median width has been established, the ditch slopes should be set as shown in Part 1-2B, Figure 2A thru 4. In no case shall the slopes be steeper than those specified for existing medians.

NOTE: The important hydraulic role of the median ditch in removing water from the roadway surface and protecting the integrity of the pavement structure cannot be overly stressed. In order to provide adequate drainage, shoulder drains and underdrains shall be considered along with median slopes, which will adequately drain both the roadway surface and subgrade. The Pavement Management Unit will make recommendations to the Roadway Design Unit on a project by project basis.

EARTH BERM MEDIAN PIER PROTECTION1-6G

With median widths 70' and less, Pier Protection shall be provided. An earth berm, guiderail, or guardrail shall be placed as pier protection, when the median width is 70'. When earth berms are placed, pier footings shall be designed accordingly and slope protection placed according to the applicable standards. An earth berm for pier protection is desirable for medians 70' wide (Roadway Standard Drawings, Std. No. 225.08). If the earth berm is not feasible or cost effective, guardrail or guiderail should be utilized.

Median widths over 80' require no impact protection. For additional information, see 17/2 in the Policy and Procedure Manual. See Roadway Standard Drawings, Std. No. 225.08.

MEDIAN DESIGN ON STRUCTURES1-6H

See Part I, Chapter 6-4 of this manual.

MEDIANS ON -Y- LINES1-6I

The type of median to be constructed in interchange areas shall be determined early in the design stage. If raised islands are proposed across the structure, this shall be shown on the structure recommendations. See Part I, Chapter 6-6 of this Manual.

MEDIAN CROSSOVER GUIDELINES1-6J**Median Crossover Guideline Statement**

Median divided facilities provide the benefits of separating opposing travel lanes, controlling left turn conflicts, allowing a recovery area for out of control vehicles, and a space for future travel lanes. Research data also concludes that the median divided facilities improve traffic flow (travel speeds), traffic operations (reduces congestion), and traffic safety (lower crash rates), when compared to non-divided facilities. Median crossovers may be necessary on median divided facilities that are not fully access controlled to allow for additional turning and through movements. A median crossover is defined as any connection of the opposing travel lanes that crosses the median of a divided highway. Median crossover includes directional crossovers, U-turns or all-movement crossovers.

Placement of crossovers should be considered carefully since crossovers introduce conflict points along a divided facility and thus may reduce the safety and capacity of the median divided facility. Therefore, it is important to follow these guidelines when considering the addition of median crossovers. The following guidelines have been developed as a guide for design engineers, traffic engineers, and field personnel when considering the placement or addition of median crossovers. The median crossover guidelines shall be used for all new crossovers, even in the cases where adjacent crossovers were approved under previous guidelines.

Types of Crossover Design

When a crossover is deemed justified by the Department, the only the crossover type that meets the operational and safety needs of the location will be considered. The type of crossover design below is listed from the most desirable to least desirable.

- Use of alternative routes and access: This level uses the existing infrastructure of streets, highways, intersections and existing crossovers to provide the mobility that a proposed crossover would serve.
- Directional Crossovers: A directional crossover provides for left-turns in one direction only. These crossovers are preferred because they provide for the predominant movement and are much safer for the traveling public. Typically, these crossovers only provide for left turns from the major route to the side street. No left turns or straight across movements are allowed from the side street. Where the minimum spacing requirements are not met and there is a defined need for left-turn access, then only a directional crossover will be considered. However, the general guidelines must be met for the directional crossover to be considered.
- Median U-turn Crossovers: Median U-turns allow a vehicle to make a U-turn and do not allow for through movement from a side street or driveway.
- All-Movement Crossovers: All-movement crossovers provide for all movements at the intersection or driveway. The use of all-movement crossovers is reserved for situations where there is sufficient spacing and other crossover designs cannot adequately meet the operational needs of the location. The use of this crossover design should be limited because it decreases capacity; increases delay and congestion; may increase pollutants from vehicles; and some studies indicate that they have a higher propensity for crashes.

General Guidelines for Median Crossover Installations on New and Existing Facilities:

All proposed median crossovers on existing and new facilities shall be evaluated from an operational and safety perspective. The availability of reasonable alternative routes, access points, existing crossovers, along with the desire to preserve the capacity and safety of the facility shall be considered in all proposed crossovers.

The availability of adequate spacing for a crossover shall be considered when determining if a crossover is justified. However, the availability of adequate spacing alone does not warrant a new crossover.

A median crossover shall only be considered when the Department deems it necessary to service traffic generated by existing (and proposed) roadways, businesses or other

MEDIAN CROSSOVER GUIDELINES (continued)

1-6J

development; and this traffic cannot be adequately serviced with the existing crossovers at intersections, reasonable alternative routes or other access points.

It is the requesting party's responsibility to provide the justification, or means to acquire the information for justification, for new crossovers. If this information is not provided, the crossover will not be reviewed or approved.

When the Department has deemed a median crossover is necessary, only the crossover type that meets the operational and safety needs of the facility will be considered.

A median crossover shall not be allowed unless an adequate length left turn deceleration lane and taper can be provided and the addition of the crossover will not impede the storage requirements of adjacent intersections. Left turn lanes will be installed to serve all non-emergency crossover movements allowed on the divided facility at the time of installation.

When crossovers are considered, U-turns must be adequately accommodated or restricted. If trucks and large vehicles are expected to use the crossover, then design vehicle shall be selected to accommodate these movements.

Median Crossovers shall not be located where intersection sight distance (both vertical and horizontal) cannot meet current NCDOT design criteria.

Median crossovers shall not be placed in areas where the grade of the crossover will exceed 5 percent. Special consideration should be given to the vertical profile of any median crossover that has the potential for future signalization to ensure a smooth crossing from a present or future side street.

While it is desirable to have median widths 23 feet of greater, a median crossover shall not be provided where the median width is less than 16 feet.

Crossovers that require a signal or where there is expected potential for a future signal in an otherwise unsignalized area should be avoided.

The Department retains the authority to close or modify any crossover that it deems to be operationally unsafe to the traveling public.

Median Crossover Guidelines for North Carolina Streets and Highways**Interstate and Non-Interstate Highways with Full Control of Access:**

No public-use median crossovers will be allowed.

U-turn median openings for use by authorized vehicles for the maintenance and policing of highway or emergency response can be allowed when an engineering study clearly indicates a need. The spacing of the median openings should abide by the following guidelines:

U-turn median openings can be provided if a need has been determined and they can be added in a safe location where decision sight distance is available. When adding a crossover, it should be located at least one half mile from any overhead structure and at least one mile from the terminus of a ramp acceleration lane or a deceleration lane. The median crossover should be signed appropriately.

The minimum spacing of adjacent U-turn median crossovers between interchanges is three miles. However, spacing alone is not justification for a crossover.

On urban freeways, the interchange spacing is generally close enough that openings are not warranted. Therefore, U-turn openings are not allowed. In addition, on facilities where acceptable gaps are unlikely due to high ADTs, U-turn openings are not allowed.

Divided Highways without Full Control Access (Posted speeds of greater than 45 mph)

On highways with higher traveling speeds, the potential for more severe crashes is greater. Also, on high-speed facilities, development is usually not as concentrated as on lower speed facilities. In order to maximize the safety of these facilities, crossover spacing is critical.

All-movement crossovers shall not be any closer than **2000 feet** apart on divided highways. However, spacing alone is not justification for a crossover. It must be determined that a crossover addition is needed to meet the operational requirements of the facility. Where this spacing requirement is not met and there is a defined need for left-turn access, then a directional crossover will be considered. However, the general guidelines must be met in order for the directional crossover to be added.

Divided Highways without Full Control Access (Posted speeds of 45 mph and less)

There is usually more demand for median crossovers and the speed limit is lower. Because of the density of the development and lower traffic speeds, it is acceptable to provide a closer spacing of median crossovers. However, the availability of adequate spacing alone is not justification for a crossover. Crossovers must be justified to meet operational and access needs that the existing facility cannot adequately serve. Only the type of crossover that meets the operational, access and safety needs of the facility shall be added. Directional crossovers are preferred where they meet the operational and access needs of the roadway.

The spacing of crossovers will be largely dependent upon the need for adequate storage for left turning vehicles/U-turn vehicles at intersections. **A crossover shall not be placed where it interferes with the storage requirement for existing intersections.**

All-movement crossovers shall not be spaced any closer than **1200 feet** apart on divided highways with posted speed of 45 mph and less. Where this spacing requirement is not met and there is a defined need for left-turn access, then a directional crossover will be considered. However, the general guidelines must be met in order for the directional crossover to be added.

Responsibility of Locating Crossovers on Active Roadway Design Projects:

While a project is in design and during the life of the construction of the project, the Project Engineer and Project Design Engineer will locate the crossovers for the highway. Only crossovers at arterials, major collectors, and major traffic generators will be shown on the hearing maps. The Division Office shall be consulted regarding the level of access management desired for the project.

The engineer in the Highway Design Branch will determine if the crossover is justified and then determine the appropriate crossover design type. Priority will be given to placing median crossovers at existing intersecting streets. After the crossovers are located for existing streets that justify a crossover, the engineer will examine the remainder of the highway facility, along with reasonable alternative routes and access points, to determine if there are any other major traffic generators that require consideration for a crossover. When considering the intermediate crossover locations, the minimum spacing as outlined previously in these guidelines is to be followed. The crossover design that meets the operational, access, and safety requirements will be shown.

All crossovers are subject to the review of the Traffic Engineering and Safety Systems Branch, the Division Office, and the appropriate local officials if applicable.

Some special circumstances may justify the need to deviate from these guidelines. If requests are made for crossovers that deviate from these guidelines, the Traffic Engineering and Safety Systems Branch and the Division Office will review the location of the crossover and offer recommendations. The State Design Engineer will be responsible for granting any exceptions to these guidelines on active design and construction projects. Prior to approval of any contractual agreements for crossovers, all negotiated crossovers must be reviewed and approved by the Traffic Engineering Branch, the Highway Design Branch, Division Office, and the appropriate local officials if applicable.

MEDIAN CROSSOVER GUIDELINES (continued)

1-6J

Some special circumstances may justify the need to deviate from these guidelines. If requests are made for crossovers that deviate from these guidelines, the Traffic Engineering and Safety Systems Branch and the Division Office will review the location of the crossover and offer recommendations. The State Design Engineer will be responsible for granting any exceptions to these guidelines on active design and construction projects. Prior to approval of any contractual agreements for crossovers, all negotiated crossovers must be reviewed and approved by the Traffic Engineering Branch, the Highway Design Branch, Division Office, and the appropriate local officials if applicable.

Final approval or denial of the request shall be the responsibility of the State Traffic Engineer. If any aspect of the requested median crossover deviates from the guidelines, the Traffic Engineering and Safety Systems Branch and the Division Office will confer to determine the necessary action to be taken. The State Traffic Engineer will be responsible for granting any exceptions to the guidelines on existing facilities. The State Traffic Engineer will notify the Division Engineer of the decision reached.

Crossovers Considered for Private Developments on Existing facilities:

A private development that justifies direct access and benefits from an added median crossover will be responsible to construct or fund its installation. In addition, it is the responsibility of the requesting party to provide the justification, or means to acquire the information for justification, for new crossovers. If this information is not provided, the crossover will not be reviewed or approved. The developer will be required to submit a complete set of plans and specify the exact location, design, and construction requirements for the proposed median crossover. Only the type crossover that meets the operational and safety needs of the facility shall be added. Directional crossovers are preferred where the design meets the operational and access needs of the roadway. Approval of such a crossover is subject to a traffic engineering investigation and approval procedures as outlined in these guidelines.

Any drainage facilities required by the construction of the crossover will be installed or funded by the developer or the applicant at their expense. After the construction has been completed in accordance with the Division of Highways requirements and standards, and passes the District Engineer inspection, the Division of Highways will assume ownership and maintenance of the crossover.

Failure to comply with the location, design, or construction requirements will result in the crossover being barricaded or removed until the deficiencies have been corrected at the applicant's expense. Once the Division of Highways assumes the ownership, the median crossover will then be subject to the regulations exercised under the police power of the State.

MEDIAN CROSSOVER GUIDELINES (continued)1-6J

The Department retains the authority to close or modify any crossover that it deems to be operationally unsafe to the traveling public; or causes undue delay, congestion or adversely impacts traffic operations.

Special Use Crossovers

Median crossovers for special purposes, such as fire protection, ambulance services, etc. shall be considered on an individual basis after a traffic engineering investigation.

Emergency response plans and expected level of need, in addition to the geometric limitations of the facility will be used in consideration for special use crossovers. Approved special use crossovers shall be appropriately designed, delineated, and regulated. However, the availability of adequate spacing alone does not warrant a new crossover.

SIDEWALK 1-7

Sidewalks are warranted on projects in accordance with Pedestrian Policy Guidelines. If sidewalk construction is proposed, it will usually be included in the project planning report.

SIDEWALK WIDTHS 1-7A

Desirable – 5' (residential), 10' (commercial and school routes)

Minimum – 4' (residential), 5' (commercial and school routes)

The above widths are adequate for most projects, but heavy pedestrian traffic may warrant wider widths.

SIDEWALK SLOPE 1-7B

Rises at 0.02 from back edge of curb and gutter.

SIDEWALK THICKNESS 1-7C

Unless unusual conditions are proposed in the planning report, 4" concrete shall be used. See Roadway Standard Drawings, Std. No. 848.01.

BERM WIDTHS WITH AND WITHOUT SIDEWALK 1-7D

The following berm widths show desirable and minimum sections. If sidewalk is not constructed initially but is anticipated, one of these sections shall be constructed. See 1-7D, F-1 for Desirable Widths and 1-7D, F-2 for Minimum Widths.

See 1-7D, F-4 for Detail for Placement of Utility Poles in Curb and Gutter sections posted 45 mph or less.

WHEEL CHAIR RAMPS 1-7E

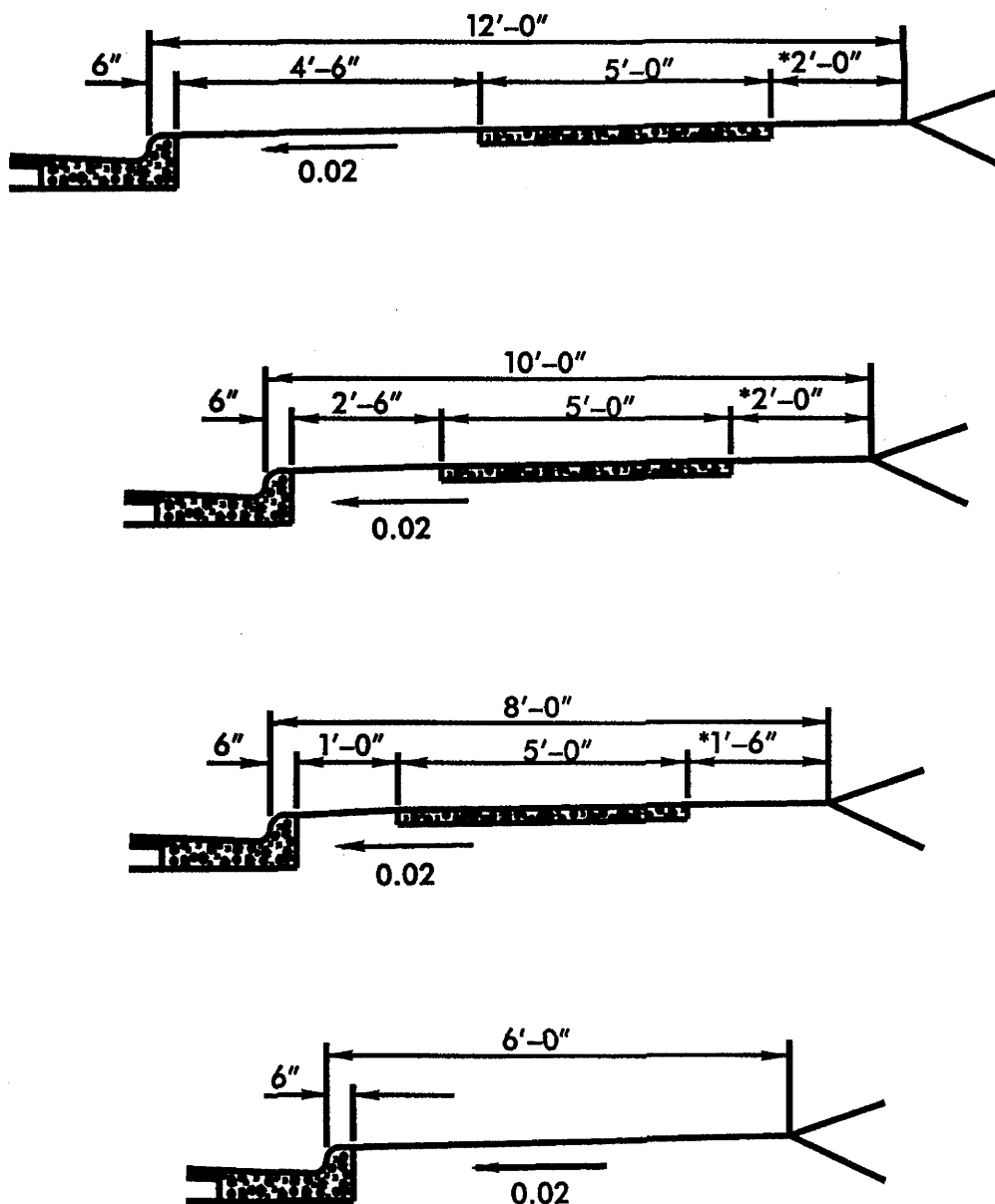
Curb ramps for the handicapped shall be designed in accordance with a manual entitled "Guidelines Curb Cuts and Ramps for Handicapped Persons". For additional information, see 5/4 in the Policy and Procedure Manual. See Roadway Standard Drawings, Std. No. 848.05 for additional information.

FIGURE 1

1-7D

F-1

DESIRABLE BERM WIDTHS

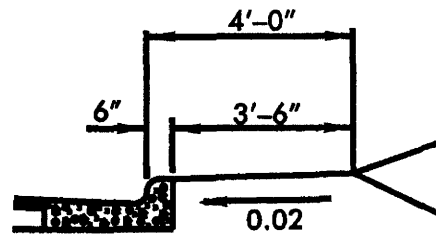
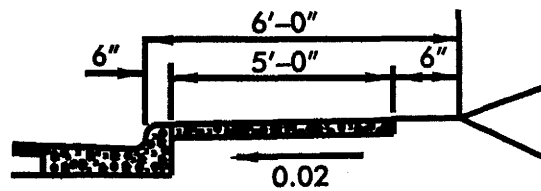
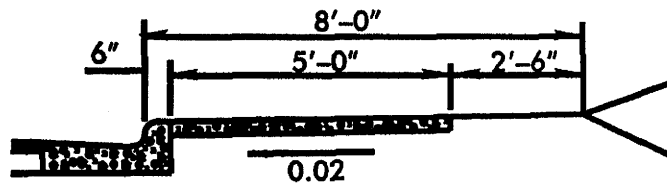


PROVIDE A CLEAR AREA OF
6' DESIRABLE (MEASURED FROM FACE) OR
4' MINIMUM (MEASURED FROM FACE)

FIGURE 2

1-7D
F-2

MINIMUM BERM WIDTHS

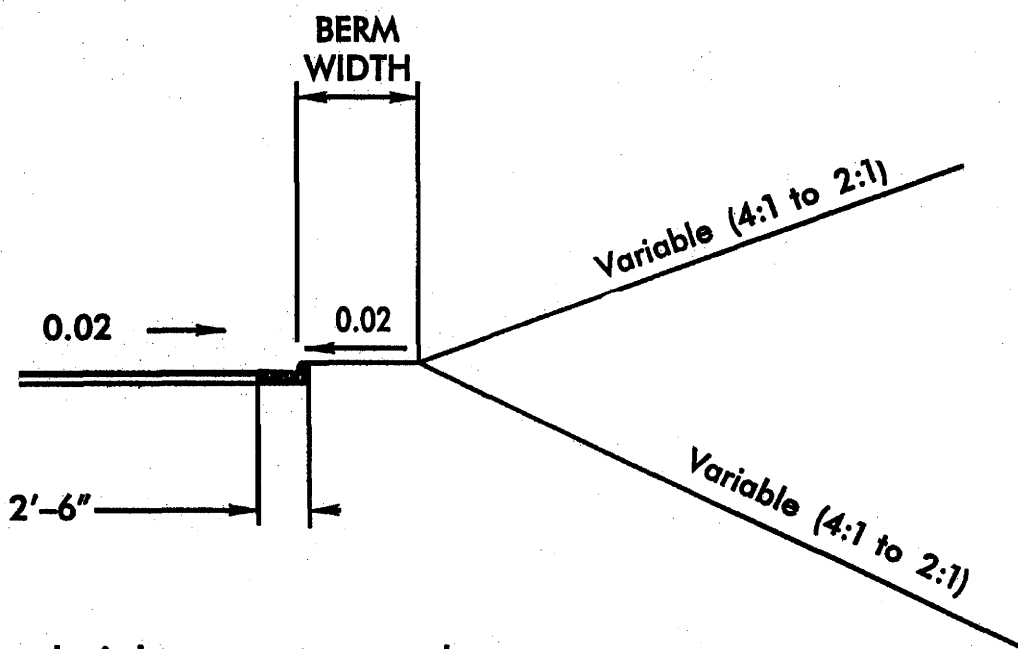


PROVIDE A CLEAR AREA OF
6' DESIRABLE (MEASURED FROM FACE) OR
4' MINIMUM (MEASURED FROM FACE)

FIGURE 3

1-7D
F-3

Proposed Typical Curb and Gutter Section Statewide

**Fill or Cut heights**

0-5'

5'-10'

>10'

slope

4:1

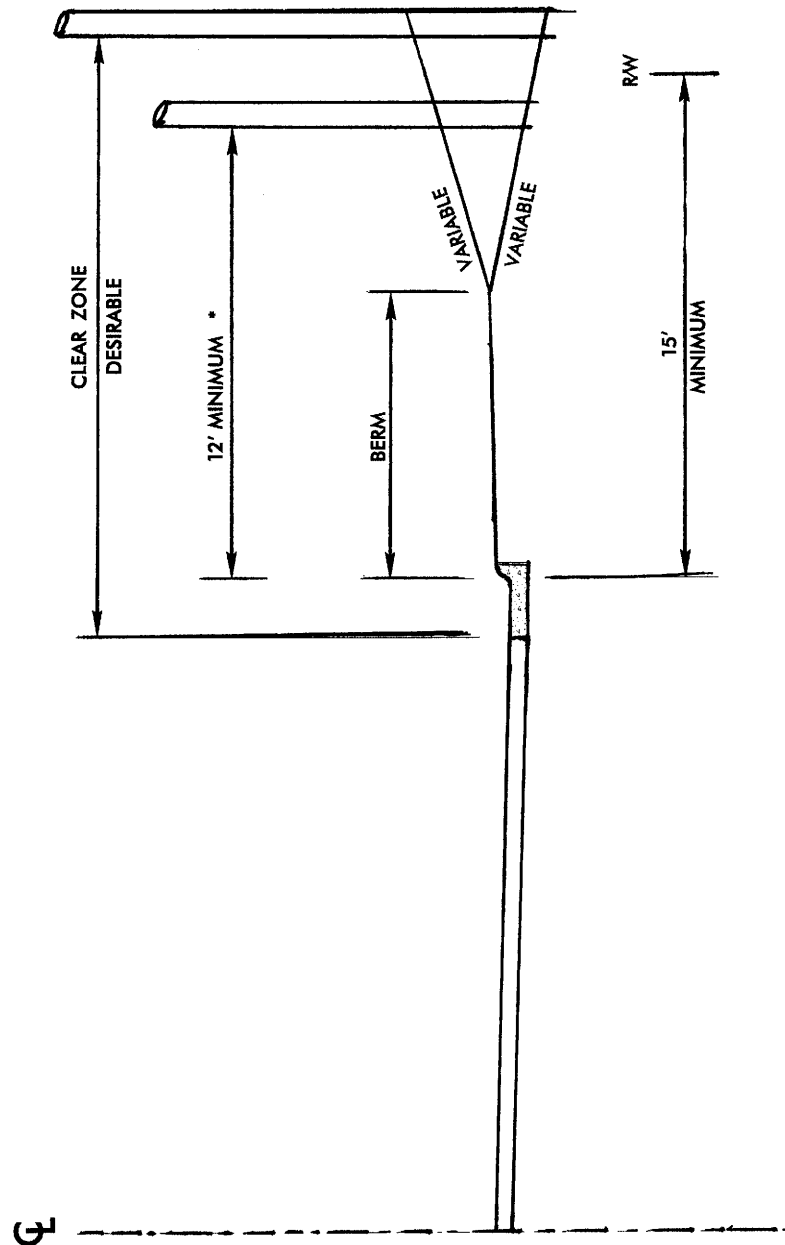
3:1

2:1

ROADWAY DESIGN MANUAL
FIGURE 4

PART 1
1 - 7 D
FIG - 4

DETAIL FOR PLACEMENT OF UTILITY POLES IN
CURB AND GUTTER SECTIONS POSTED 45 MPH OR LESS



* UTILITY POLES PLACED CLOSER THAN 12 FEET SHALL BE BREAKAWAY POLES

RAISED ISLANDS

1-8

Flush pavement with markings is often more desirable than raised islands especially where speeds exceed 45 mph. However, when it has been determined that raised islands will be required, both construction and maintenance costs should be considered.

In most instances, monolithic construction should be utilized on islands up to 16' in width due to greater cost-effectiveness, ease and speed of placement, and reduced future maintenance requirements. For widths greater than 16', cost-comparisons should be made between monolithic islands and 3" concrete covered islands with curb and gutter to determine the most cost-effective design. In making the determination, consideration should be given to the projected maintenance cost-savings of the monolithic island and the traffic operation requirements for the particular project.

Full depth pavement is normally utilized under the narrower bulb-type islands and under raised median islands when traffic operations during construction will require vehicular traffic in the median area. When traffic operations are not required in the median, it is more economical to place the monolithic island on a compacted aggregate base.

In special cases, grassed, landscaped, or covered islands may be used in urban or residential areas where recommended by the Division Engineer and approved by the Roadside Environmental, Construction, and Maintenance Units. These islands provide an aesthetically pleasing appearance with all surroundings, but only when well maintained. The construction costs of grassed or landscaped islands are considerably lower than those of monolithic or covered islands. However, the greatly increased maintenance costs and the increased danger involved in maintenance operations prevents these islands from normally being justified except under unusual circumstances.

When any type of concrete curb is proposed on a project and it is not in accordance with Roadway Standard Drawings, Std. No's. 846.01, 852.01, and 852.02, a special detail shall be shown in the plans. The Contract Office Project Engineer in Design Services shall be consulted prior to drawing any details. This section has developed several concrete curb configurations that provide satisfactory results. For raised island treatment on structures, see this Manual Part I, Chapter 6-6G.

STANDARD CONCRETE CURB AND GUTTER

1-9

See Roadway Standard Drawings, Std. No. 846.01.

All utility poles shall be placed outside the Clear Zone as defined by the 2002 Roadside Design Guide.

For Curb and Gutter where posted speed is 45 MPH or less, all utility poles shall be placed outside the Clear Zone where practicable. If this cannot be achieved due to right of way restraints, the utility pole may be placed a minimum of 12 feet from the face of the curb. All utility poles that are placed closer than 12 feet shall be breakaway poles. See Figure 1-7D, F-4 for Detail.

STEPS

1-10

The type of steps to construct shall be determined by the Division Engineer. When existing steps are being disturbed, it is customary to replace the same type of step. For additional information, see Roadway Standard Drawings, Std. No's. 844.01 and 844.02.

SPIRAL CURVES

1-11

Spiral curves are required on interstates, freeways, expressways and all major arterials. Where terrain and topography restrict their use, the Project Engineer will have the option to delete spirals on collector roads, local roads and streets, and on minor arterials with a design speed less than 45 mph. Spirals (including tangent runout) should be avoided on bridges and in all cases should not begin or end on the bridge. In cases where spirals are absolutely required on bridges, the increment spacing should be equally spaced across the entire length of the bridge.

There are several methods for computing the length of Spirals. The recommended method for determining spiral lengths is to use A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2001), Chapter 3.

COMPOUND SPIRALS

1-11A

Compound Spirals should be used between two curves if the radius of one curve is twice the radius of the second curve.

Compound Spirals should also be used on all interstates, freeways, expressways, arterials, and on ramps in interchange areas as the preferred method to change superelevation rates.

Minimum Superelevation Runoff and Tangent Runout Lengths

See “A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS ” (2001),
EXHIBIT 3-29.

Minimum Radius for Design of Rural Highways, Urban Freeways, and High-Speed Urban Streets Using Limiting Values of (e) and (f).

See “A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS ” (2001),
EXHIBIT 3-14.

Diagrammatic Profiles Showing Methods of Attaining Superelevation

See “A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS ” (2001),
EXHIBIT 3-37.

SUPERELEVATION RATES (continued)

1-15

If maximum superelevation rates are used other than those shown the guidelines, it shall be discussed with the appropriate Roadway Design Assistant Unit Head.

SUPERELEVATION GUIDELINES

TYPE OF ROADWAY	LOCATION & CONDITIONS	SUPERELEVATION ⁽¹⁾
Interstates & Freeways	<ul style="list-style-type: none"> Statewide 	.08 or .10 (2)
Ramps & Loops	<ul style="list-style-type: none"> Statewide 	.08
Flyovers (Directional ramps with bridges)	<ul style="list-style-type: none"> Statewide 	.06
Arterials & Rural Collectors	<ul style="list-style-type: none"> Statewide Limited Access 	.08
Arterials & Urban Collectors with 60 mph design speed or greater	<ul style="list-style-type: none"> Statewide Partial or no control of access 	.06
Urban Collectors with 50 mph or less design speed	<ul style="list-style-type: none"> Statewide Curb & Gutter or shoulders with driveways 	.04
Bridge replacement projects, locals, & Secondary Roads	<ul style="list-style-type: none"> Statewide 	.04 or .06 Choose table that fits characteristics of area

(1) Refers to particular design superelevation table shown in the 2001 AASHTO "Green Book" (pages 156 to 165) that the designer should use.

(2) Don't use in locations susceptible to icy conditions.

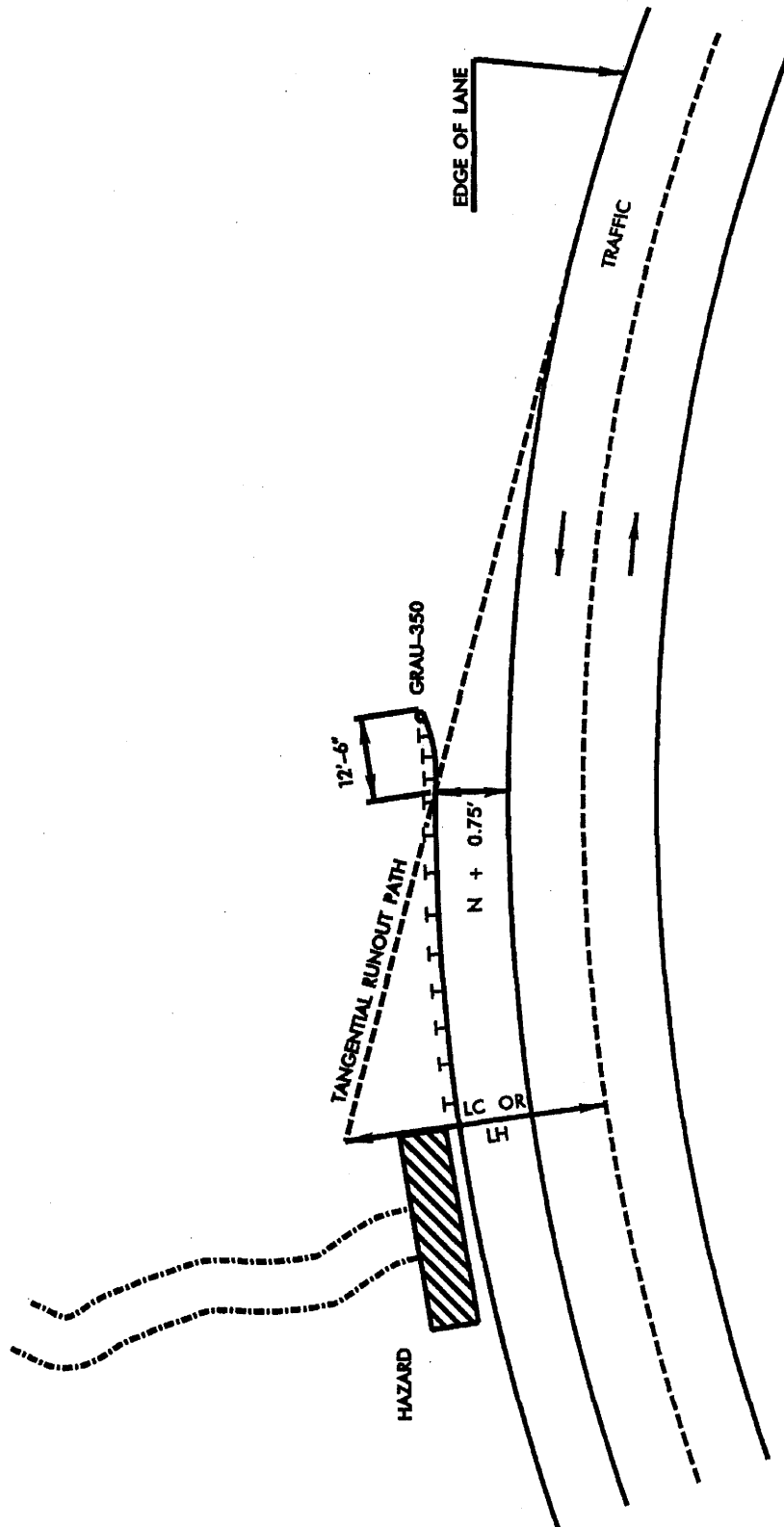
Bridges – it is desirable to use a degree of curve that the superelevation will not exceed .06 on any bridge.

Effective 9/9/2004

Revision 3

DETAIL 2D

3 - 2D



DETAIL OF GUARDRAIL PLACEMENT ON APPROACH END OF HAZARD LOCATED ON A HORIZONTAL CURVE

GUARDRAIL ANCHOR UNITS

3-2E

The anchor units most commonly used are listed and their usage is described below:

Guardrail Anchor Unit Type 350: (GRAU-350)

The GRAU-350 is a crashworthy tangential end section, which is used along the outside shoulders in instances where there is a chance of hitting the guardrail “head-on” within the vehicle’s clear zone. Locations where this end section is used are as follows:

On the approach ends of guardrail along the outside shoulders.

On the trailing ends of guardrail along two lane two way roadways.

On the trailing ends of guardrail along outside shoulders where the end of the guardrail is within an opposing vehicle’s clear zone.

As stated previously, the GRAU-350 is a tangential end unit. However, these units will be flared over the last 50 feet to provide a 1-foot offset. This minimal flare allows the terminal to be offset so that no component of the unit extends beyond the face of the guardrail. The tangential end unit should not be flared greater than a 50:1 flare rate.

No curb is allowed within the limits of this unit.

Median Anchor Unit Type 350: (M-350)

M-350 anchor units are flared end sections. Within the medians along dual lane bridge approaches, there is a need to flare the guardrail to move it away as quickly as possible from the inside travel lane. The flared guardrail must be anchored with a flared end section. Therefore, the M-350 Anchor unit is used in the following situations:

Within the median on the approach to a dual lane bridge.

Within the median on the trailing end of a dual lane bridge if the backside of the approach anchor unit is within the clear zone. (See Roadway Standard Drawings, Std. No. 862.01, Sheet 2)

The M-350 has a flare and is flared for a distance of 37.5 feet. The unit has a 4 foot offset. No curb is allowed within the limits of this unit.

Cable Anchor Terminal: (CAT-1)

The Cable Anchor Terminal (CAT-1) end treatment is not crashworthy and should only be used at locations where there is not an opportunity to have a “head-on” hit within a vehicle’s clear zone.

GUARDRAIL ANCHOR UNITS (continued)

3-2E

Typically, the CAT-1 is used on the trailing end of guardrail along multi-lane highways. (Exceptions would be in the median as noted in the previous discussion of the M-350).

Anchor Terminal: (AT-1)

The Anchor Terminal's (AT-1) usage is limited to anchoring the shop curved guardrail at intersections, which have radii between 20 to 75 feet. Typically, vehicles will be approaching the intersection at a lower speed in order to stop. Therefore, this anchor system is appropriate for this condition. (Refer to Roadway Standard Drawings, Std. No. 862.01 Sheet 7 for an example of this application).

Terminal End Section:

This end section is not an anchor unit. As its name implies, it is an end section, which is placed at locations where an anchor unit is not needed. Typically, the terminal end section is placed on sections of guardrail that are used to terminate or "dead-end" roadways.

Structure Anchor Units:Type III:

The anchor unit is used to anchor guardrail on all types of bridge or approach slab rails. (See Roadway Standard Drawings, Std. No. 862.03, Sheets 2 and 3). The 4" curb adjacent to the anchor unit is not required in locations where the bridge rail is behind the sidewalk.

Type B-77 (with rubrail):

This guardrail anchor unit is used to attach guardrail to concrete Jersey Shape barrier as illustrated in Roadway Standard Drawings, Std. No. 857.01. This anchor unit can also be used on existing bridges with a Jersey shape barrier rail that has no approaching curb. The anchor unit has a rubrail, which prevents vehicles from "snagging" the barrier. See Roadway Standard Drawings, Std. No. 862.03.

Type B-83

This anchor unit should be used on existing bridges with a Jersey shape barrier and a curb on the approach slab. The curb must extend the full pay limits of the guardrail anchor unit. This may require additional curb construction.

DETERMINING TOTAL GUARDRAIL LENGTH3-2F

The total length guardrail needed at an installation is obtained by adding the length of need to the guardrail length which is needed throughout the limits of the hazard, and then deducting the applicable anchors' unit length. Anchor unit deductions, to be used in calculations, are listed below: The total length of guardrail should be rounded so it is divisible by 12.5 ft.

ANCHOR DEDUCTIONS

<u>ANCHOR</u>	<u>DEDUCTIONS</u>
GRAU-350	50.0'
M-350	37.5'
CAT-1	6.25'
AT-1	6.25'
*Type III	18.75'
*B – 77	18.75'
*B – 83	25.0'

*Measured from the end of the bridge or approach slab rail.

GUARDRAIL INSTALLATION AT INTERSECTIONS3-3

When installing guardrail around intersections, care must be taken to ensure adequate sight distance is maintained at the intersection. Also, the guardrail should not impede the turning path of a vehicle. When guardrail is warranted around an intersection, provide as much offset as possible from the edge of the travel lane to the face of the guardrail. This will ensure adequate sight distance and place the guardrail farther from a vehicle's turning path.

In installations along curb and gutter facilities, the guardrail should preferably be placed 12 feet from the face of the curb instead of at the face of the curb. If 12 feet is not available, place the guardrail, as far away from the face of the curb as the berm width will allow. When guardrail is placed at the face of the curb, sight distance and the vehicle's turning ability is impeded.

See Roadway Standard Drawings, Std. No. 862.01, Sheet 7, for a pictorial view showing placement of guardrail at intersections.

GUARDRAIL ON -Y- LINES

3-4

The addition of guardrail where warranted should be considered throughout the construction limits along a Y-line. Remember lower speeds on the Y-line may negate the need for guardrail.

Whenever guardrail is used to shield bridge ends on Y-lines with three (3) or more lanes, no guardrail is warranted on the trailing end of the bridge when fill slopes are 4:1 or flatter. The elimination of the guardrail on the trailing end of the bridge will improve sight distance at ramp intersections, which are downstream of the bridge.

GUARDRAIL INSTALLATIONS ADJACENT TO CURBS AND/OR GUTTERS

3-5

On curb and gutter facilities with a traveling speed of 35 mph or less, guardrail is generally not required. On low speeds, the vehicle is not likely to vault the curb so the curb itself tends to act as a barrier.

On curb and gutter facilities with traveling speeds of greater than 35 mph, guardrail is warranted to protect motorists from fill slope hazards or fixed object hazards, which exist within the clear zone. Methods of placement for guardrail in each situation are described below:

Fill Height and Slope Warrant, Preferred Placement: The preferred treatment is to place the face of the guardrail 12 feet from the face of the curb. The 12 feet width provides ample sight distance for any intersecting streets or driveways near the guardrail installation. This placement method will also accommodate for sidewalk installation. The guardrail will be placed behind the sidewalk.

To provide for the above installation, the berm width would have to be 14 feet. (See Roadway Standard Drawings, Std. No. 862.01 Sheet 11.

Fill Height and Slope Warrant: When right of way restrictions prohibit the use of the preferred treatment, the guardrail should be placed so the face of the guardrail aligns with the face of the curb. If sidewalk exists or is proposed, the sidewalk may have to be flared at the anchor unit installation.

High-Speed facilities frequently require a curb/guardrail combination, on outside shoulders, to control surface drainage and reduce erosion of fill slopes. The expressway gutter/guardrail combination is only to be used when the Hydraulics Unit recommends it on freeways with 3 or more lanes of pavement sloped in the same direction. The situation generally occurs on the low side of a superelevated curve in a fill section. Use the shoulder berm gutter/guardrail combination to meet this requirement at all other locations.

GUARDRAIL / GUIDERAIL TREATMENT IN MEDIAN LOCATIONS

3-6

Guidelines for typical Median Guardrail / Guiderail Installations:

Incorporate median guardrail / guiderail on all freeway projects with median widths of 70 feet or less.

Two types of installations will be used: Cable guiderail or steel beam guardrail with 6'-3" post spacing (semi-rigid guardrail).

Cable guiderail can be used when slopes of 6:1 or flatter exist in the median. Cable guiderail deflects up to 12'. When using cable guiderail, insure that the deflection of the rail does not extend within the opposing travel lane.

Steel beam guardrail has to be placed on 10:1 or flatter slopes. Steel beam guardrail (6'-3" post spacing) normally deflects 3'. When using steel beam guardrail (6'-3" post spacing) to protect from rigid obstacles, insure the face of the guardrail is placed 5' - 6" from the face of the hazard. (Refer to offset distance note on Roadway Standard Drawings, Std. No. 862.01, Sheet 1.)

Weak post steel beam guardrail will be used in freeway medians that have adjoining segments of weak post guardrail in place at each end of the project. Currently, NCDOT is not proposing to use weak post guardrail in any other locations. This guardrail is flexible and has 12'-6" post spacing. The normal deflection of this guardrail is 7'. Weak post guardrail has to be placed on slopes 10:1 or flatter.

It is desirable to place the guardrail as far from the edge of the travel lane as the above guidelines will allow.

Typical Placement in Various Median Widths:

30 feet: **Typically, use two rows of semi-rigid guardrail. (Assuming slopes steeper than 6:1 exist in the median)

36 feet: **Two rows of semi-rigid guardrail if slopes are steeper than 6:1.

One line of cable guiderail (approximately 4' from the centerline of the ditch) if median slopes are 6:1 or flatter.

46 feet: One line of cable guiderail if slopes are 6:1 or flatter. (Place approximately 4' from the centerline of the ditch).

**Two lines of semi-rigid guardrail if slopes are steeper than 6:1.

GUARDRAIL / GUIDERAIL TREATMENT IN MEDIAN LOCATIONS (cont.) 3-6

60 feet and above: one line of cable guiderail placed approximately 8' from the center of the ditch.

****If two lines of guardrail are required, place semi-rigid guardrail. (The two lines of steel beam guardrail should not pose as much maintenance problems as two lines of cable guiderail.)**

The above are guidelines only and will not cover every possible situation that will be encountered. Each location will have to be studied and evaluated in conjunction with the previous information, to determine an appropriate median guardrail treatment.

Roadway Standard Drawings have not been developed for the following conditions. These conditions can be detailed on the plan view itself.

Two Rows of Semi-Rigid Guardrail at Median Piers (30' - 36' MED):

The semi-rigid guardrail will serve as pier protection. Ensure that the face of the semi-rigid guardrail (3'- 1½" post spacing) can be placed at a minimum distance of 3' - 6' from the face of the bridge piers (See note on Roadway Standard Drawings, Std. No. 862.01, Sheet 1 which describes minimum offset to piers).

Use of Cable Guiderail with Earth Berm Protection:

It is still desirable to use earth berm protection in median widths of 68' and 70'. When using the earth berm, stop the cable guiderail at an approximate distance of 225' from the beginning of the concrete slope protection.

(Refer to Roadway Standard Drawings, Std. No. 225.08 for Earth Berm Protection. The cable rail will stop between sections D and E as shown on this standard. The distance from the concrete slope protection will be 225' as calculated from the Roadway Standard Drawings, Std. No. 225.08.).

Guardrail is not required in medians wider than 80', when the bridge pier is located in the center of the median.

If the earth berm is not feasible or cost effective, concrete barriers, guardrail, guiderail and/or impact attenuators should be used.

GUARDRAIL / GUIDERAIL TREATMENT IN MEDIAN LOCATIONS (cont.) 3-6

SPECIAL MEDIAN GRADING

The Roadway Engineers and Hydraulics Engineers must consider Special Median Grading. Highway plans Submitted to the Hydraulics Unit shall include information as follows:

1. Modified Cross-Sections as specified by Roadway Standard Drawings;
 - a. STD. No. 225.08, Sheet 1
 - b. STD. No. 862.01, Sheet 1
 - c. STD. No. 862.01, Sheet 2
 - d. STD. No. 865.01, Sheet 2
2. Cross reference the plan sheets to the applicable standard by showing,
“Note: See Cross-Sections and Roadway Standard Drawings,
STD. No. _____, Sheet _____ for Special Median Grading.”
3. The plan sheets shall show Guardrail and/or Impact attenuators requiring special grading. Use the longest Impact attenuator, permitted by the Special Provisions, for grading limits, (See Part I, 3-12, Table 1 of this manual for lengths.)
4. Label beginning and ending of Special Grading on plan sheets.
5. Inform the Hydraulics Engineer of altered drainage patterns or low points created by Special Median Grading.

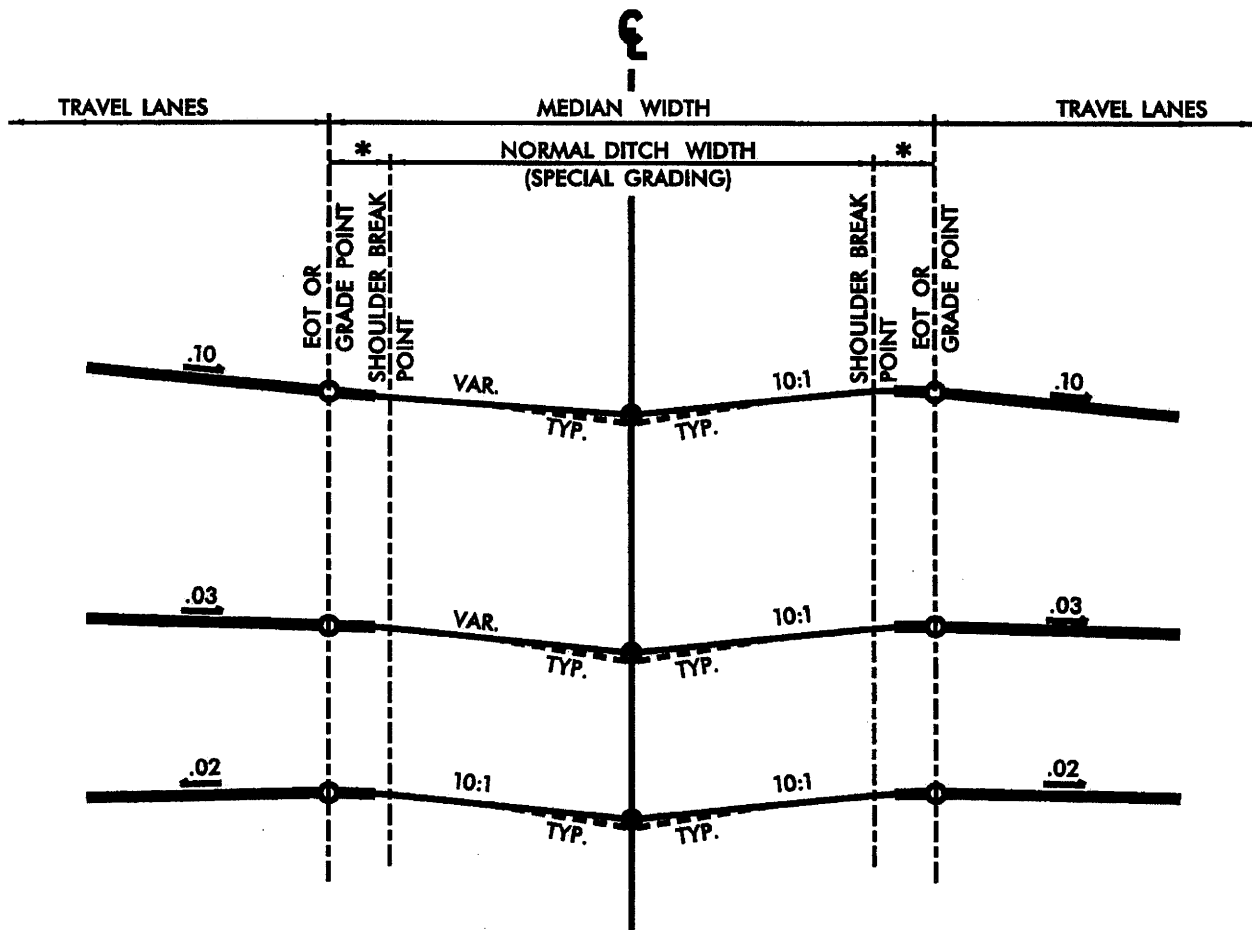
Special grading in Superelevated locations shall have Standard Median Shoulder slopes (See Roadway Standard Drawings Nos. 560.01 and 560.02). Use a 10:1 slope from the higher median shoulder break point to establish the elevation at the center of the median. Next extend a slope from the lower median shoulder break point to the center of the median elevation, as established above, to complete the Median Cross-Section (See Part I, 3-6, Figure 1, of this manual for further information).

FIGURE 1

3-6

F-1

SPECIAL GRADING IN SUPERELEVATED LOCATION



*** MEDIAN SHOULDER WIDTH—
SEE STANDARDS 560.01 AND 560.02 FOR
METHOD OF SHOULDER CONSTRUCTION.**

GUARDRAIL TREATMENT UNDER BRIDGES

3-7

1. With Outside Bridge Piers:

A. With a Concrete Barrier:

If the outside pier is 15'-6" or less from the edge of the main travel lane, use a concrete barrier and guardrail (Roadway Standard Drawings, Std. No. 857.01).

The guardrail should be extended from the concrete barrier according to the length of need requirements as outlined in Section 3-2 of this manual.

B. Without a Concrete Barrier:

If the face of the bridge pier is greater than 15'-6" from the edge of the main travel lane but within the clear recovery area, then use guardrail to protect the pier. The face of the guardrail will normally be placed 5'-6" from the face of pier, but usually no less than 12' from the edge of the main travel lane. (See Roadway Standard Drawings, Guardrail Placement Std. No. 862.01, Sheet 1).

The guardrail should be extended based on the length of need requirements as outlined in Section 3-2 of this manual.

2. Without Outside Bridge Piers:

A. Approach With a Natural or False Cut:

No guardrail is needed if the 6' vertical curve is used with Roadway Standard Drawings, Std. No's. 225.07 and 610.03.

B. Approach in a Fill without a False Cut:

Guardrail is normally placed 6' to 12' from the edge of a local, collector, or auxiliary lane, and 12' to 20' from the edge of a main travel lane. Guardrail spacing at the end bent slope will typically be 6'-3". The guardrail should be extended based on the length of need requirements as outline in Section 3-2 of this manual.

3. With Curb and Gutter:

Note: For curb and gutter facilities with traveling speeds greater than 35 mph, guardrail will be warranted for the protection of bridge piers. The guardrail should be placed so the face of the guardrail aligns with the face of the curb.

ELIMINATION OF BRIDGE SHOULDER PIERS

In order to facilitate future widening and increase safety and aesthetics, shoulder piers should be eliminated at grade separations.

For a copy of the Guardrail Summary Sheet "sample", Please contact NCDOT Design Services Unit, Special Services Group.

REV. 1/2/02

TABLE 11

STRUCTURAL PLATE STEEL PIPE
6" x 2" Corrugations – Bolted Fabrications Maximum Fill Heights Over Top of Pipe

SIZE	MIN. COVER OVER TOP OF PIPE	0.109" 12 GAGE		0.138" 10 GAGE		0.168" 8 GAGE		0.188" 7 GAGE		0.218" 5 GAGE		0.249" 3 GAGE		0.280" 1 GAGE		0.280" * 1 GAGE	
		CIR.	ELONG	CIR.	ELONG	CIR.	ELONG	CIR.	ELONG	CIR.	ELONG	CIR.	ELONG	CIR.	ELONG	6 Bolts ELONG	18 Bolts ELONG
60	12"	42	42	61	62	70	81	76	93	86	112	96	132	106	144	184	220
66	12"	38	38	49	58	60	74	64	85	72	102	80	120	83	130	168	198
72	12"	35	35	38	51	50	67	53	77	59	93	65	108	71	118	157	181
78	12"	32	32	36	47	44	62	46	71	51	83	55	100	60	109	143	159
84	12"	30	30	35	44	39	57	41	66	45	75	49	95	52	102	131	145
90	12"	28	28	33	40	35	53	37	61	40	72	43	84	45	91	122	133
96	12"	26	26	31	38	33	50	34	58	36	70	39	78	41	82	115	124
102	24"			29	36	31	47	32	54	34	65	36	72	38	75	107	117
108	24"			27	34	29	45	30	51	32	62	34	68	35	70	102	112
114	24"			26	33	28	42	29	48	31	58	32	63	34	65	96	107
120	24"			25	31	27	40	28	46	29	56	30	60	33	62	92	104
126	24"					26	37	26	44	27	52	29	58	30	59	86	100
132	24"					25	36	25	42	26	50	28	56	29	58	83	98
138	24"					24	34	25	39	25	48	27	54	28	55	79	94
144	24"					24	33	25	38	25	46	26	52	27	54	76	92
156	24"					23	31	23	35	24	43	25	50	26	52	70	85
168	24"					23	28	23	33	23	40	24	47	25	50	65	78
180	24"					22	27	22	31	23	37	23	44	24	48	61	73
192	24"					22	25	22	29	23	35	23	41	23	45	57	69
204	36"					22	23	22	27	22	33	22	39	23	42	54	65

* EXCELLENT BACKFILL 95% DENSITY

PIPE CLASSIFICATIONS

5-12

Pipe classifications will be provided by the Hydraulics Unit for cross drains under high type pavement, for special situations, and for storm drains and special drainage systems. (High type pavement is any Portland Cement Concrete Pavement, or any Asphalt Concrete Pavement at least 2" thick.)

For cross drains under low type pavement, the contractor has the option of using either reinforced concrete pipe culverts or bituminous coated corrugated steel pipe culverts unless otherwise specified by the Hydraulics Unit. Pipe alternates shall be shown on the summary sheets.

For driveway pipe through 24", the type of pipe will be optional between plain concrete pipe culverts, HDPE smooth lined corrugated plastic pipe and corrugated steel pipe culverts. Pipe shall be shown on the summary sheets. The above procedure will be followed unless otherwise specified by the Hydraulics Unit.

For temporary detours, use plain C.S. Pipe Culverts.

See 5-12, Figure 1 of this Chapter for a detail showing typical pipe installations.

For additional information on drainage quantities sheets, see Part II, 8-2 of this Manual.

MEDIAN DROP INLETS

5-13

Narrow slot grates (Std. No's. 840.24 & 840.29): use with median drop inlets on non-controlled access projects and projects with heavy pedestrian traffic.

Wide slot grates (Std. No's. 840.20 & 840.22): use with median drop inlets on controlled access projects; however narrow slot grates (Std. No's. 840.24 & 840.29) will be used at locations where pedestrian traffic is anticipated.

Traffic bearing drop inlets (Std. No's. 840.35 or 840.36): use within 4'-0" of lanes, except when placed in a concrete traffic island.

Steel frames and flat steel grates (Std. No. 840.37): use where it has been determined that traffic bearing drop inlets are needed on controlled access projects in locations that pedestrian traffic is not anticipated. The Traffic Engineering and Safety Systems Branch or the Hydraulics Unit may specify other locations where these must be used due to special considerations such as in a travel lane.

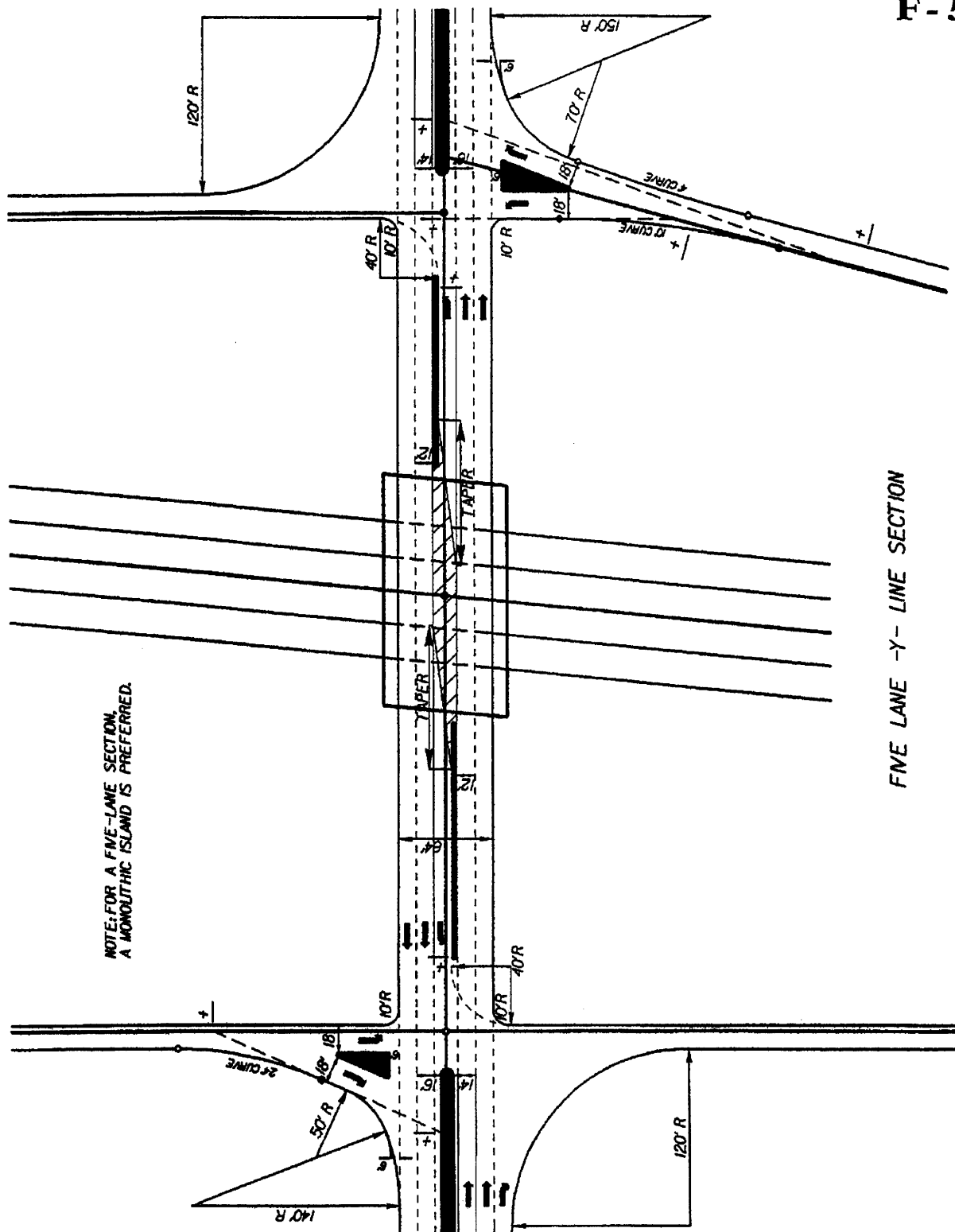
Traffic bearing drop inlet Std. No. 840.36 is used exclusively with steel frame and grates.

STANDARD CATCH BASINS

5-14

Use type "E", "F", or "G" grates on standard catch basins unless specified otherwise by the Hydraulics Unit and discussed on field inspection with Division personnel. See Roadway Standard Drawings, Std. No. 840.03. Catch Basins, Std. No. 840.01 or 840.02, placed in 2'-6" curb and gutter are suitable for use adjacent to travel lanes.

8 - 14
F - 5



RAMP TERMINAL DESIGN

JUSTIFICATION OF LEFT TURN LANES ON TWO-LANE HIGHWAYS

8-15

The need for a left turn lane on an interchange -Y- line should be carefully evaluated by the designer, since it affects the width of the interchange bridge. The need for a left turn lane is determined by traffic volumes, speed, and safety benefits.

The method for determining the warrants for left turn lanes at unsignalized at-grade intersections (applicable to interchange ramp terminals) is addressed in the attached nomograph. The method utilizes a nomograph based on opposing volumes, left turn volumes, and through volumes. The time delays and queuing characteristics of the traffic volumes are the criteria utilized in establishing these nomographs.

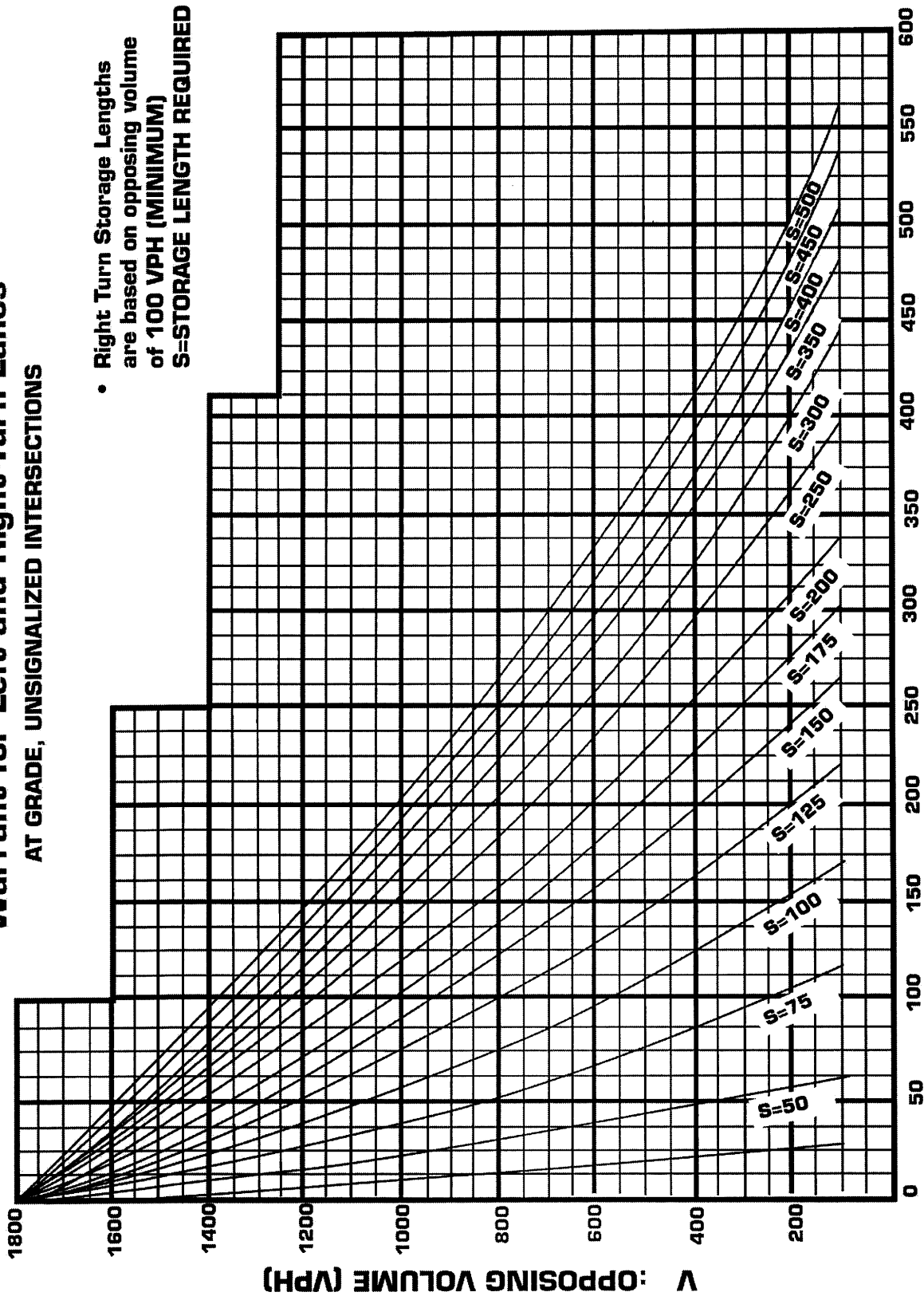
The elements to be used in entering the appropriate nomograph are:

- Operating speed (see A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2001), ch. 2).
- V_o , opposing traffic volume
- V_L , left turning volume(VPH)
- V_a , advancing traffic volume, including through, left turning, and right turning vehicles (design hour volume).
- V_R , right turning volume(VPH)
- S , storage length required

If the intercept of V and V_a falls right of the applicable S line, that is the amount of storage warranted.

Warrant for Left and Right-Turn Lanes AT GRADE, UNSIGNALIZED INTERSECTIONS

- Right Turn Storage Lengths are based on opposing volume of 100 VPH (MINIMUM)
S=STORAGE LENGTH REQUIRED



Note: Where adjacent signalization may provide opportunities for gaps in the traffic stream a reduction in the above storage values can be considered on a case by case basis.

V_L : LEFT TURNING VOLUME (VPH)
 V_R : RIGHT TURNING VOLUME (VPH)

CHAPTER NINE

AT GRADE INTERSECTIONS

"BULB" TYPE CHANNELIZATION

9-1

Intersection "Bulbs" shall be designed in accordance with the Policy and Procedure Manual 23/1. When there is not adequate space to show intersection details on the plans, intersection detail sheets shall be inserted. Information shown on the sheets shall be restricted to design criteria only that is necessary for the construction of the intersection.

NOTES: 1) Bulb type intersections are to be used on all rural, unsignalized, and divided facilities on both paved and unpaved -Y- lines.

2) For additional information, see Chapter 9-1, Figures 1 and 2.

FIGURE 1

9 - 1

F - 1

NOTES:

SEE POLICY AND PROCEDURE MANUAL 23/1 FOR
POLICY ON BULB TYPE INTERSECTIONS.

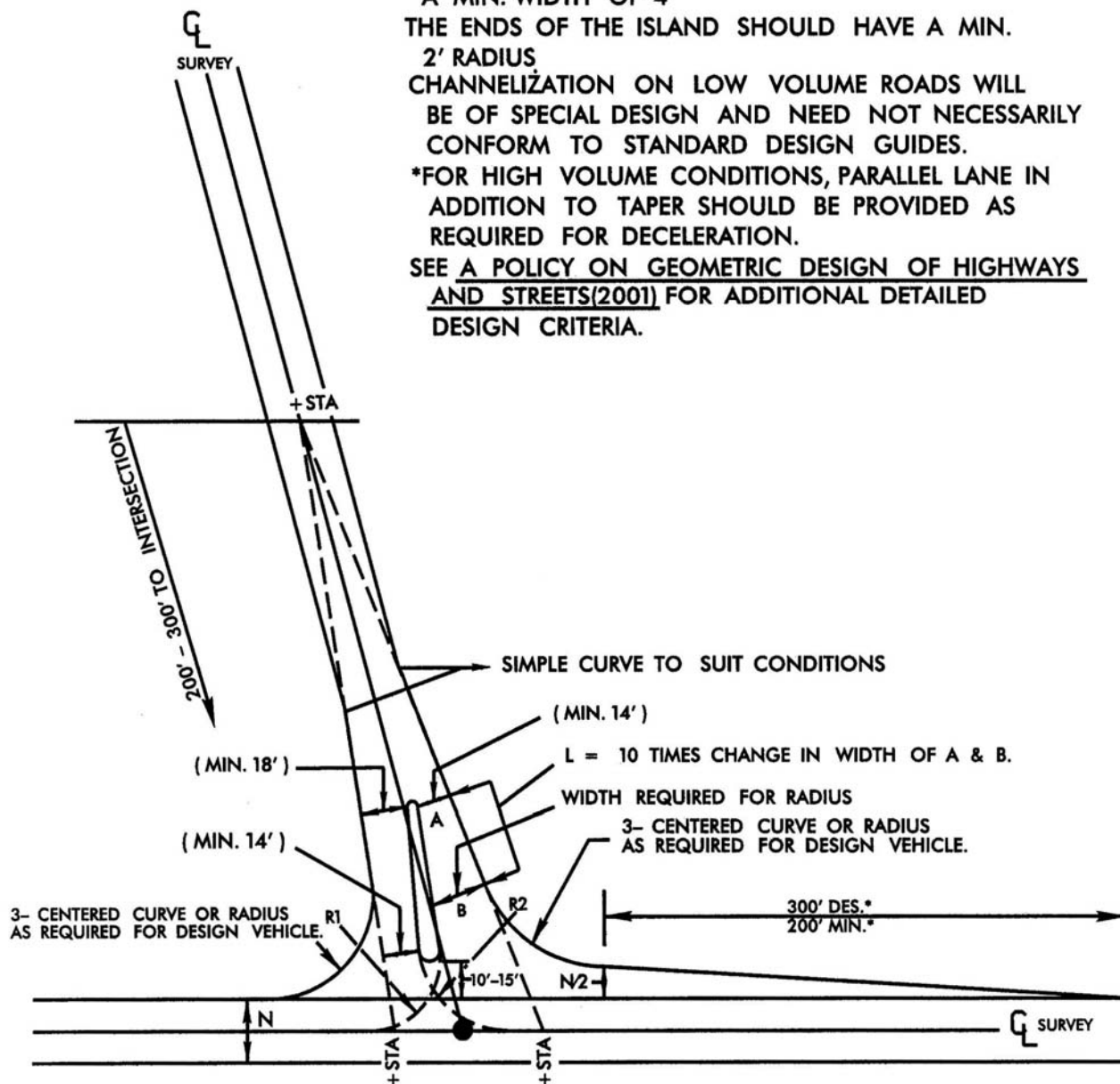
THE DESIRABLE WIDTH OF THE ISLAND IS 8' WITH
A MIN. WIDTH OF 4'

THE ENDS OF THE ISLAND SHOULD HAVE A MIN.
2' RADIUS

CHANNELIZATION ON LOW VOLUME ROADS WILL BE OF SPECIAL DESIGN AND NEED NOT NECESSARILY CONFORM TO STANDARD DESIGN GUIDES.

*FOR HIGH VOLUME CONDITIONS, PARALLEL LANE IN ADDITION TO TAPER SHOULD BE PROVIDED AS REQUIRED FOR DECELERATION.

SEE A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS(2001) FOR ADDITIONAL DETAILED DESIGN CRITERIA.



DESIGN GUIDE I

INTERSECTION WITH TWO-LANE FACILITY USING RIGHT-TURN TAPER

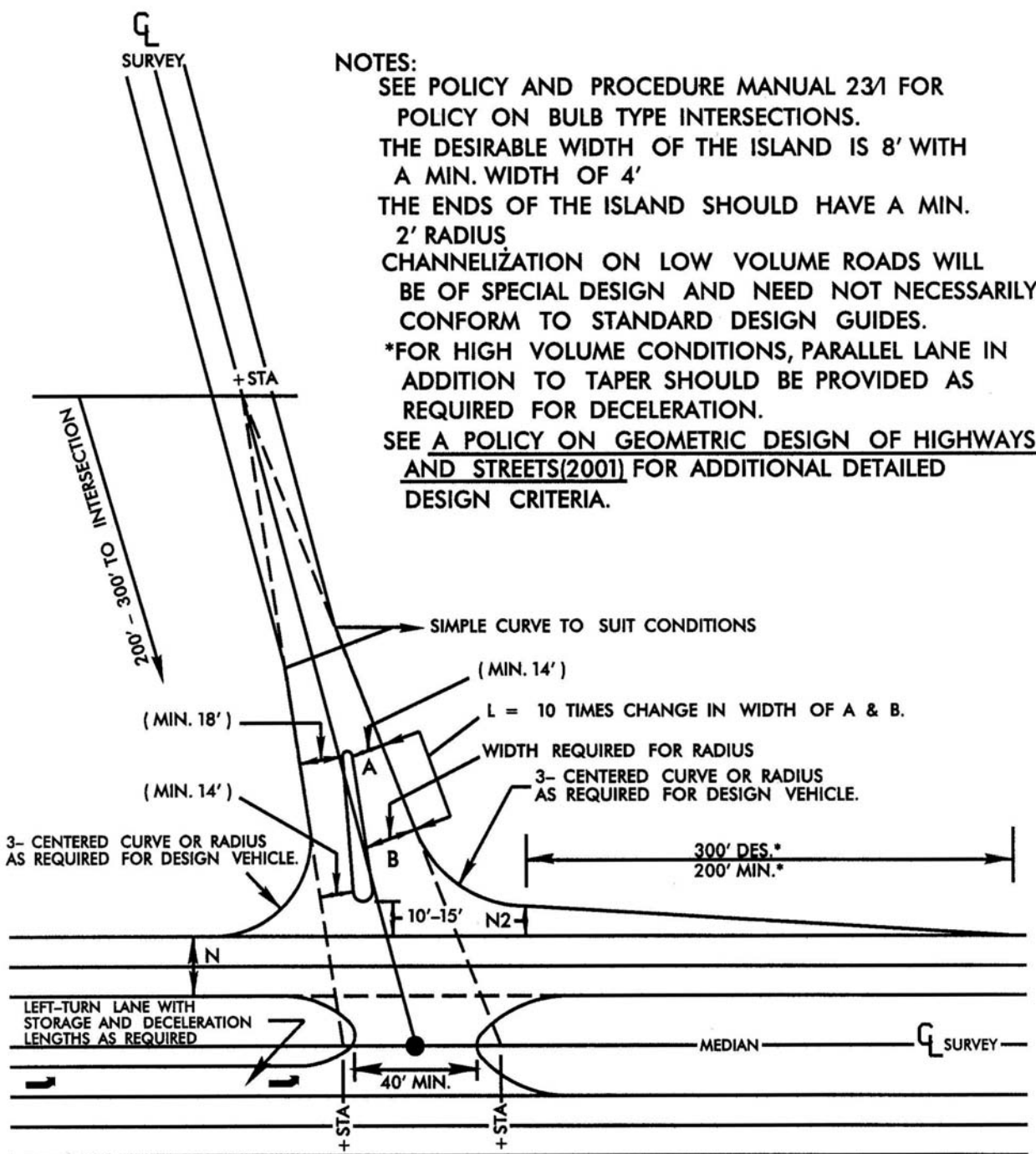
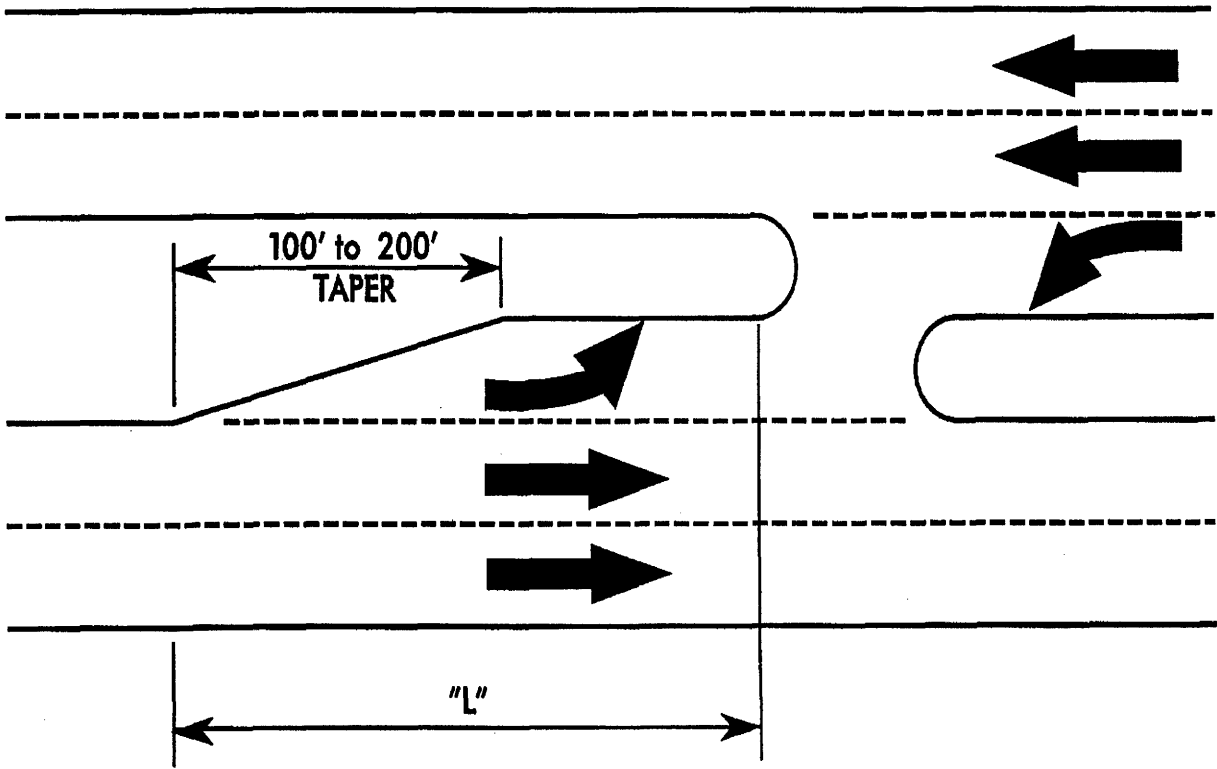
FIGURE 2**9 - 1****F - 2****DESIGN GUIDE II****INTERSECTION WITH FOUR-LANE DIVIDED FACILITY**

FIGURE 3

9 - 1

F - 3

DECELERATION LENGTHS FOR MEDIAN
CROSSOVERS AND LEFT TURNING MOVEMENTS



"L" (WHERE VEHICLE STORAGE DOES NOT GOVERN)
NO WAITING VEHICLES

DESIGN SPEED	
40	MPH
50	MPH
60	MPH

"L"
315'
430'
530'

FIGURE 3A

9-1
F3-A

**Guidelines for Use of Positive Offset
Left Turn Lanes on Median Divided Facilities**

Positive offset left turn lanes will be required on median divided facilities where the median width is greater than 20 feet and the following criteria is met.

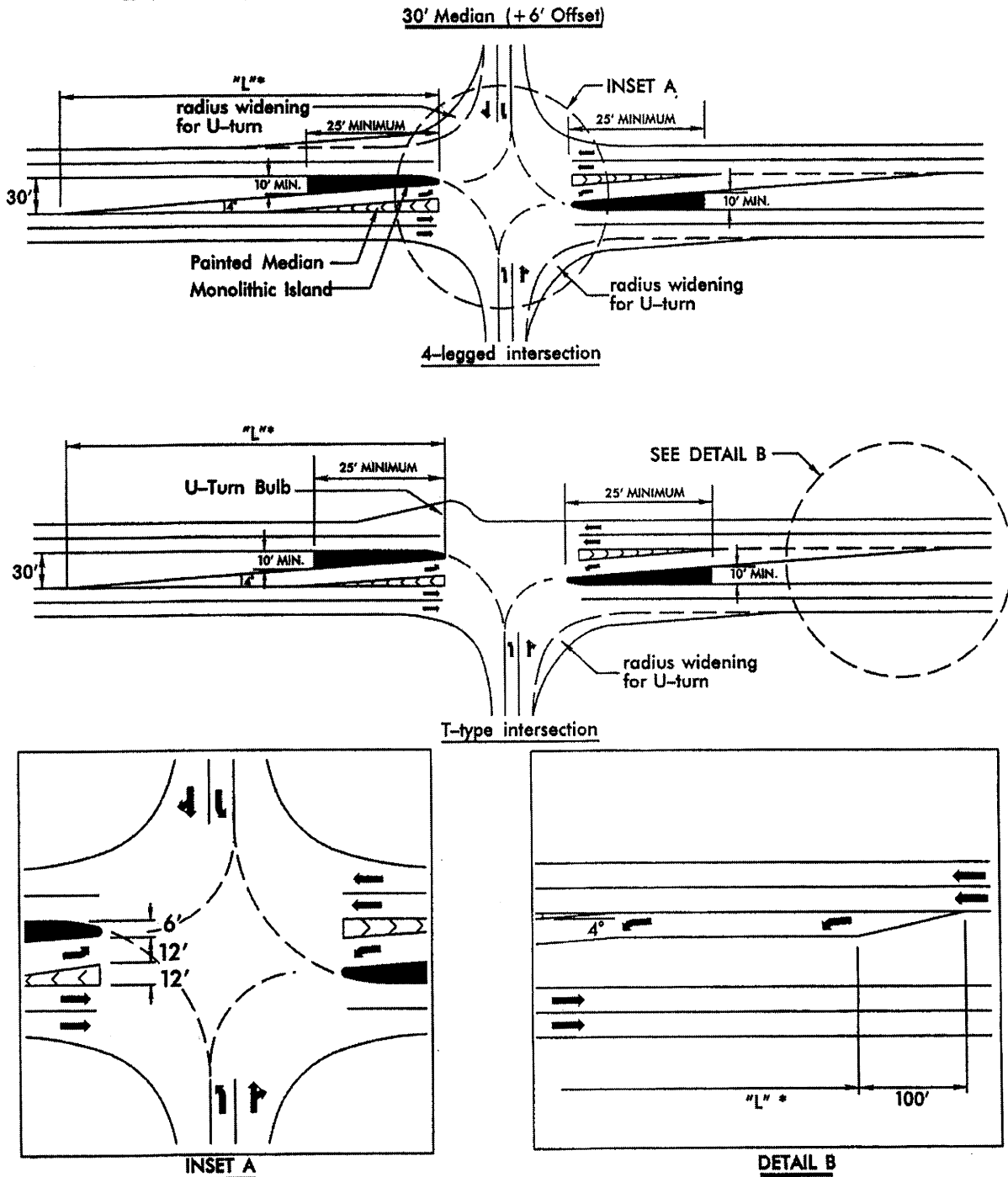
1. Use at all proposed *signalized* intersections which meet either of the following criteria:
 - a. If left turns are designed with exclusive* movements due to inadequate horizontal and/or vertical alignment and there is adequate cross section width available;
 - b. TEE intersections with opposing left turn lanes for U-turn traffic
 2. Use at all *unsignalized* intersections which meet either of the following criteria:
 - a. If 10 year traffic projections satisfy any signal warrants;
 - b. Major route left turns meet or exceed 60 vph during the peak hour
 3. Use at locations where the engineer determines that its use will improve or provide safer or more efficient traffic operations.
 4. Positive offset left turn lanes on median divided facilities should be discussed at the preliminary field inspection.
- * Positive offset left turn lanes will help to enhance exclusive left turn signal operations by reducing the time required for the left turn movements to clear the intersection.

FIGURE 3A**9 - 1**
F - 3A - 1**GUIDELINES FOR OFFSET OPPOSING
LEFT-TURN LANES ON DIVIDED ROADWAYS****"L" (WHERE VEHICLE STORAGE DOES NOT GOVERN)**

DESIGN SPEED	"L"
40 MPH	315'
50 MPH	430'
60 MPH	530'

FIGURE 3A**9-1****F - 3A - 2**

GUIDELINES FOR OFFSETTING OPPOSING LEFT-TURN LANES ON DIVIDED ROADWAYS



***Note:**

A 4 degree skew angle will provide approximately 340' of deceleration lengths for design speeds up to 40 mph. A parallel deceleration lane can be incorporated for design speeds 50 mph and higher or where additional storage length is required. See Detail B

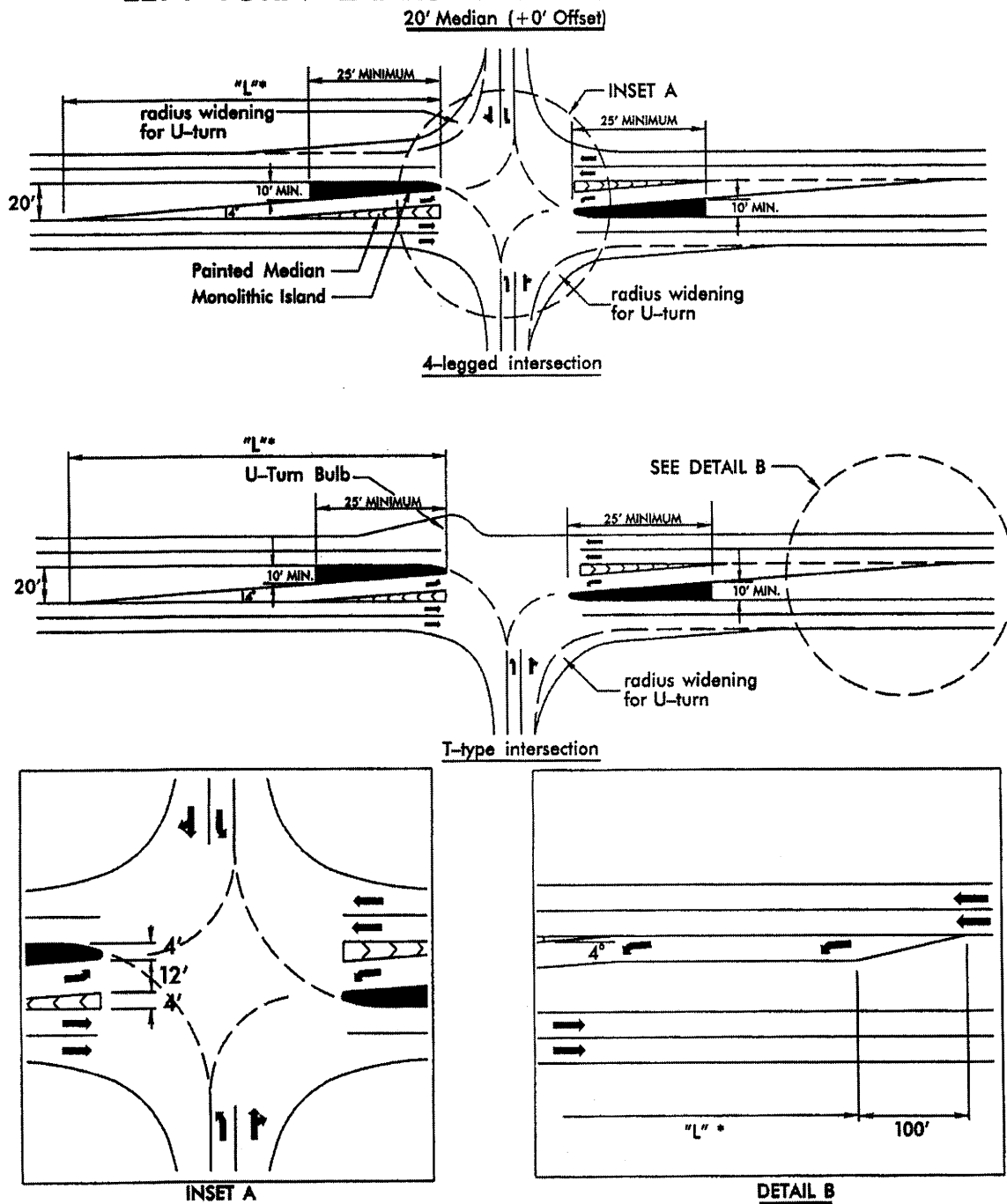
Design U-turns for passenger vehicles unless project information dictates otherwise.

FIGURE 3-A

9-1

F - 3A - 3

GUIDELINES FOR OFFSETTING OPPOSING LEFT-TURN LANES ON DIVIDED ROADWAYS



*Note:

A 4 degree skew angle will provide approximately 230' of deceleration lengths for design speeds up to 30 mph. A parallel deceleration lane can be incorporated for design speeds 40 mph and higher or where additional storage length is required. See Detail B

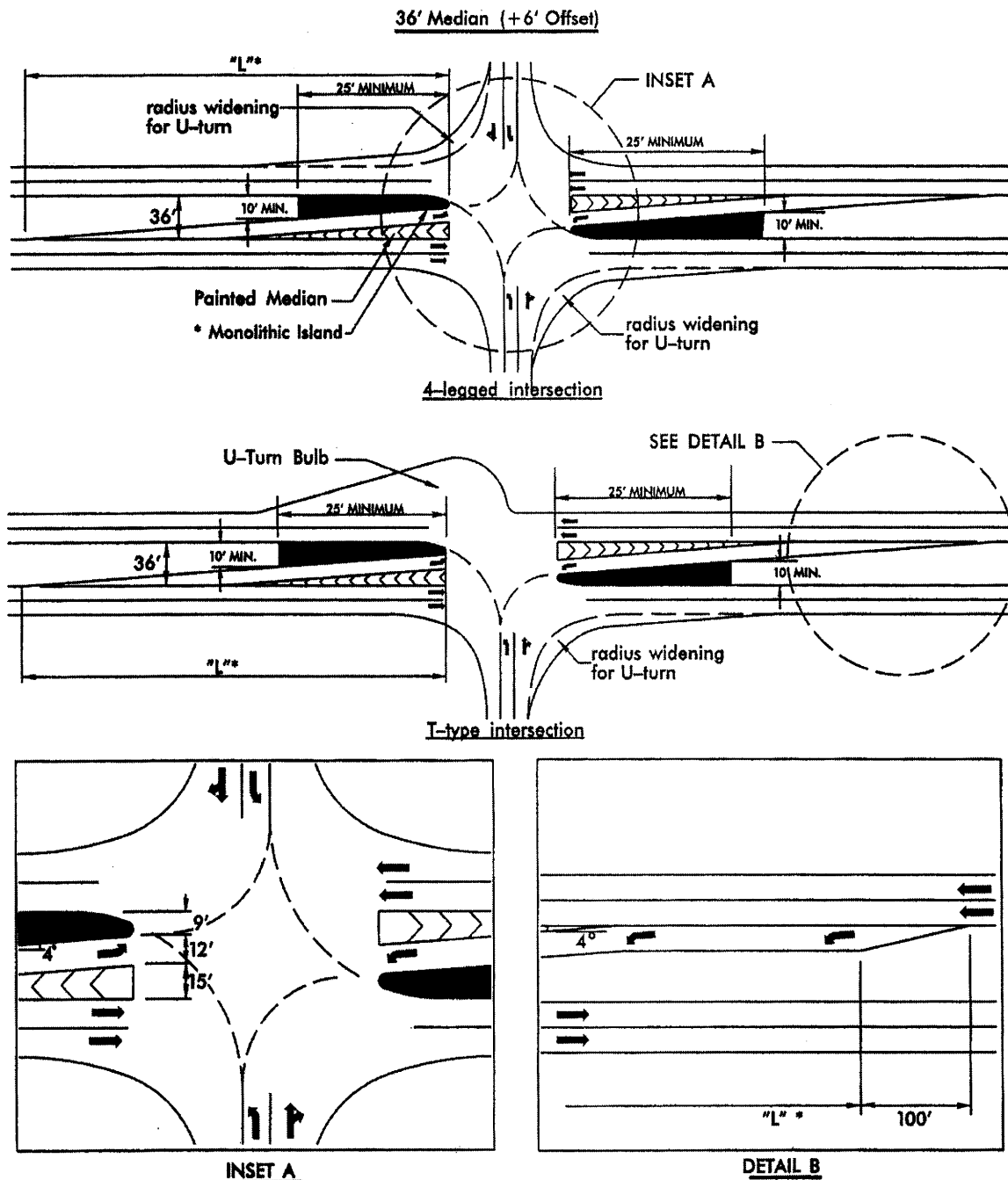
Design U-turns for passenger vehicles unless project information dictates otherwise.

FIGURE 3-A

9-1

F - 3A - 4

GUIDELINES FOR OFFSETTING OPPOSING LEFT-TURN LANES ON DIVIDED ROADWAYS

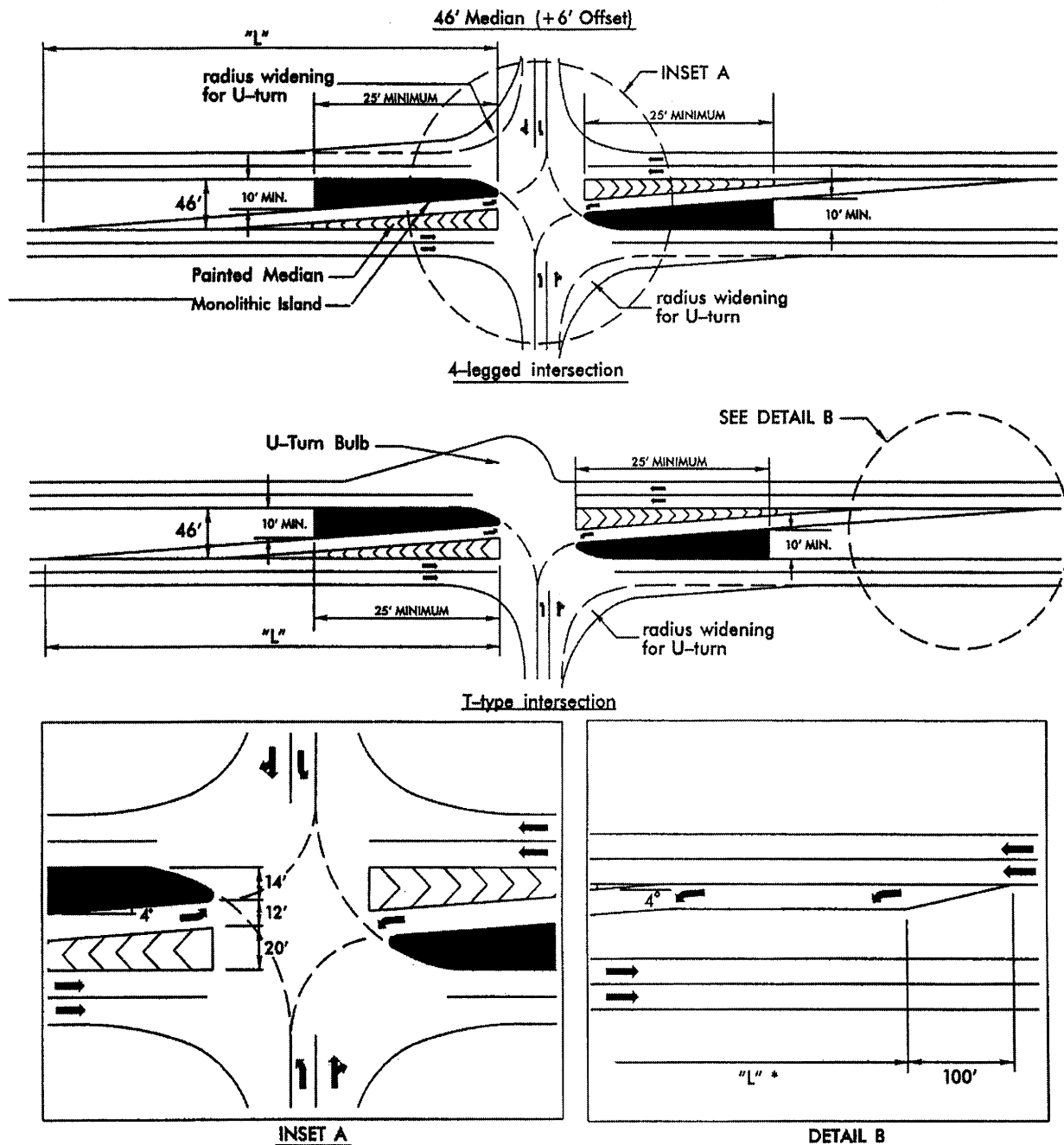


***Note:**
A 4 degree skew angle will provide approximately 385' of deceleration lengths for design speeds up to 40 mph. A parallel deceleration lane can be incorporated for design speeds 50 mph and higher or where additional storage length is required. See Detail B

Design U-turns for passenger vehicles unless project information dictates otherwise.

FIGURE 3-A**9-1****F - 3A - 5**

GUIDELINES FOR OFFSETTING OPPOSING LEFT-TURN LANES ON DIVIDED ROADWAYS



***Note:**
A 4 degree skew angle will provide approximately 455' of deceleration lengths for design speeds up to 50 mph. A parallel deceleration lane can be incorporated for design speeds 60 mph and higher or where additional storage length is required. See Detail B

Design U-turns for passenger vehicles unless project information dictates otherwise.

GUIDELINES FOR RIGHT TURN LANE WARRANTS, LEFT AND RIGHT TURN LANE STORAGE LENGTHS AND TAPER LENGTH

9 - 1

F - 4

RIGHT TURN WARRANTS

Figure 4 charts determine the warrants for either a full right turn lane, taper only, or radius only. These charts were taken from NCHRP 279, "Intersection Channelization Design Guide," figure 4-23. They were developed from a 1981 Virginia Highway and Transportation Research Council Report.

LEFT AND RIGHT TURN LANE LENGTHS

Once the right turn warrant has been determined and also figures F-4 A, B, and C determine the minimum turn lane or taper length. The left turn lane lengths were revised to reflect the 2001 AASHTO Design Book. This revision basically excluded the taper from the required deceleration length. These lengths are found in A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2001) edition, page 718. There were some concerns raised that these revised lengths (deceleration length plus taper length) were excessive. After reviewing in the field, we agreed. Therefore, we recommended revising the turn lane lengths to the distances shown below which include the taper. The justification for including the taper as part of the deceleration length is found in A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (2001) edition, page 718. It states: Desirably, the total length of the auxiliary lane should be the sum of the length for these three components (taper plus deceleration plus storage length). Common practice, however, is to accept a moderate amount of deceleration within the through lanes and to consider the taper as part of the deceleration length.

Design Speed	Minimum Right and Left Turn Lane Lengths*	Taper Only For Right Turns
40 mph	110 '	230'
50 mph	430 '	265'
60 mph	530 '	300'

*This length includes the taper. The taper length can range from a minimum of 90' to a maximum of 150'.

GUIDELINES FOR RIGHT TURN LANE WARRANTS, LEFT AND
RIGHT TURN LANE STORAGE LENGTHS AND TAPER LENGTH

9 - 1

F - 4

FIGURE 4 (Continued)

The turn lane lengths have been discussed with the FHWA and no design exceptions are required for the above lengths. As with any guidelines, there will be exceptions based on site conditions and engineering judgement. However, these guidelines should provide some overall consistency.

FIGURE 4

9 - 1

F - 4 A

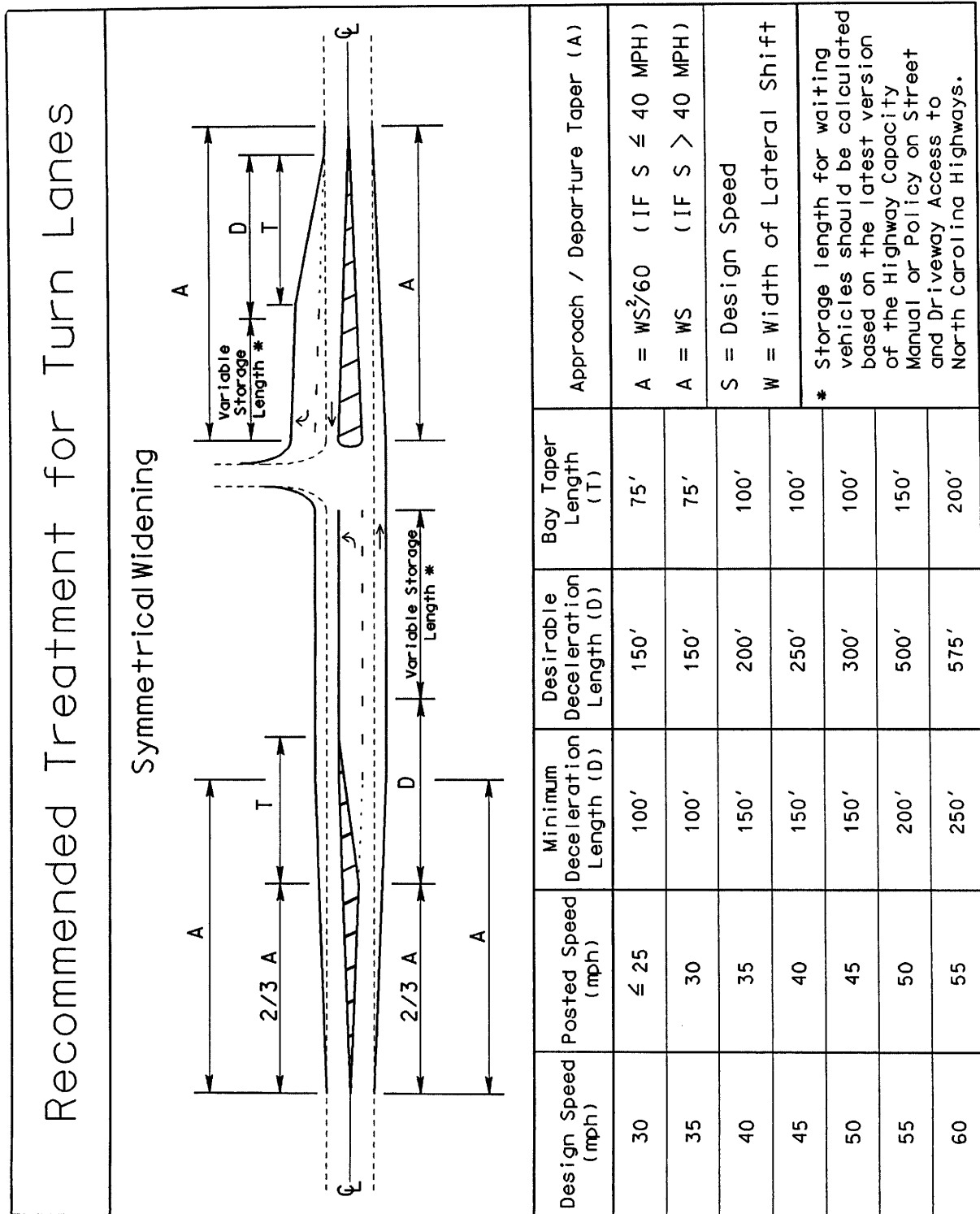


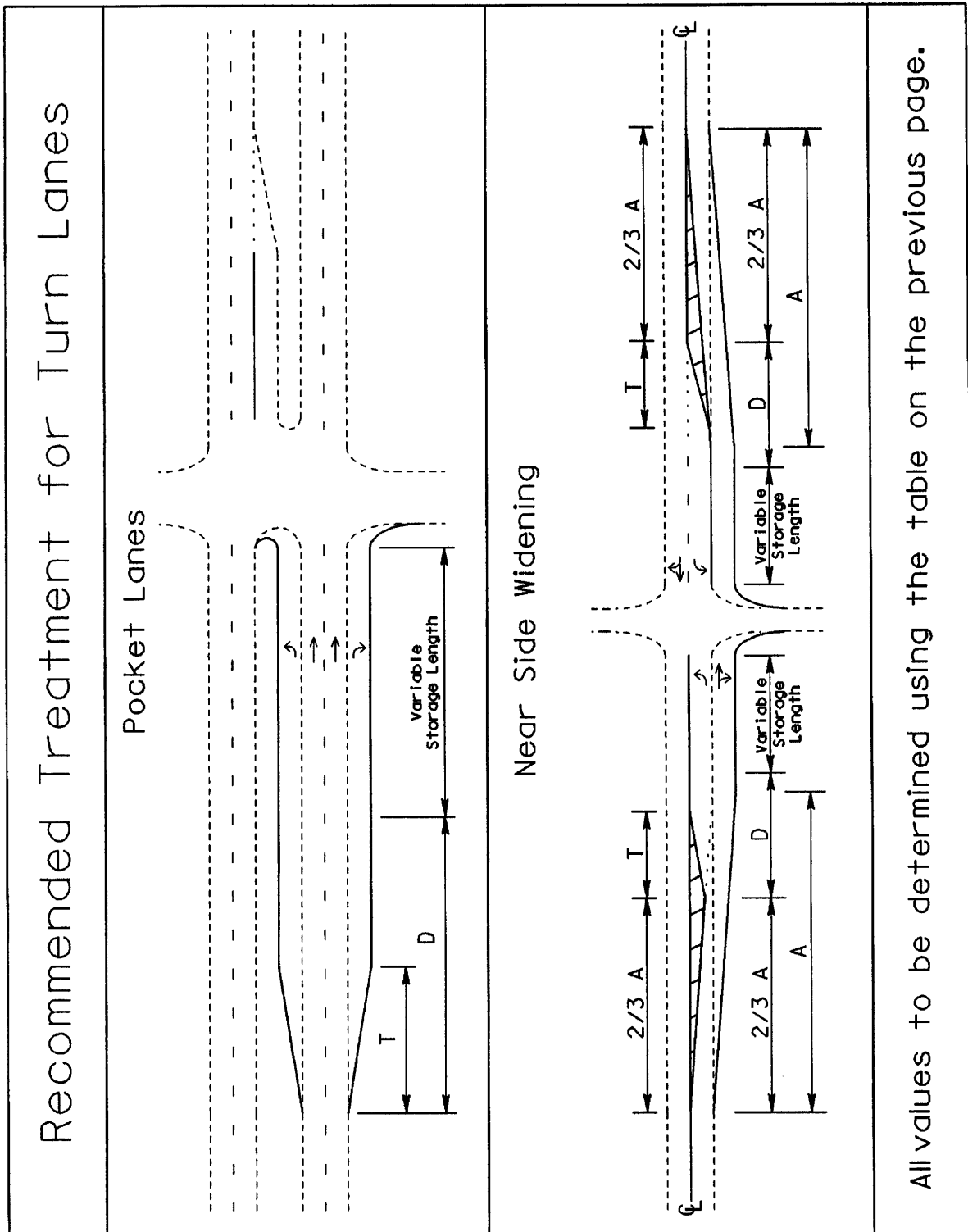
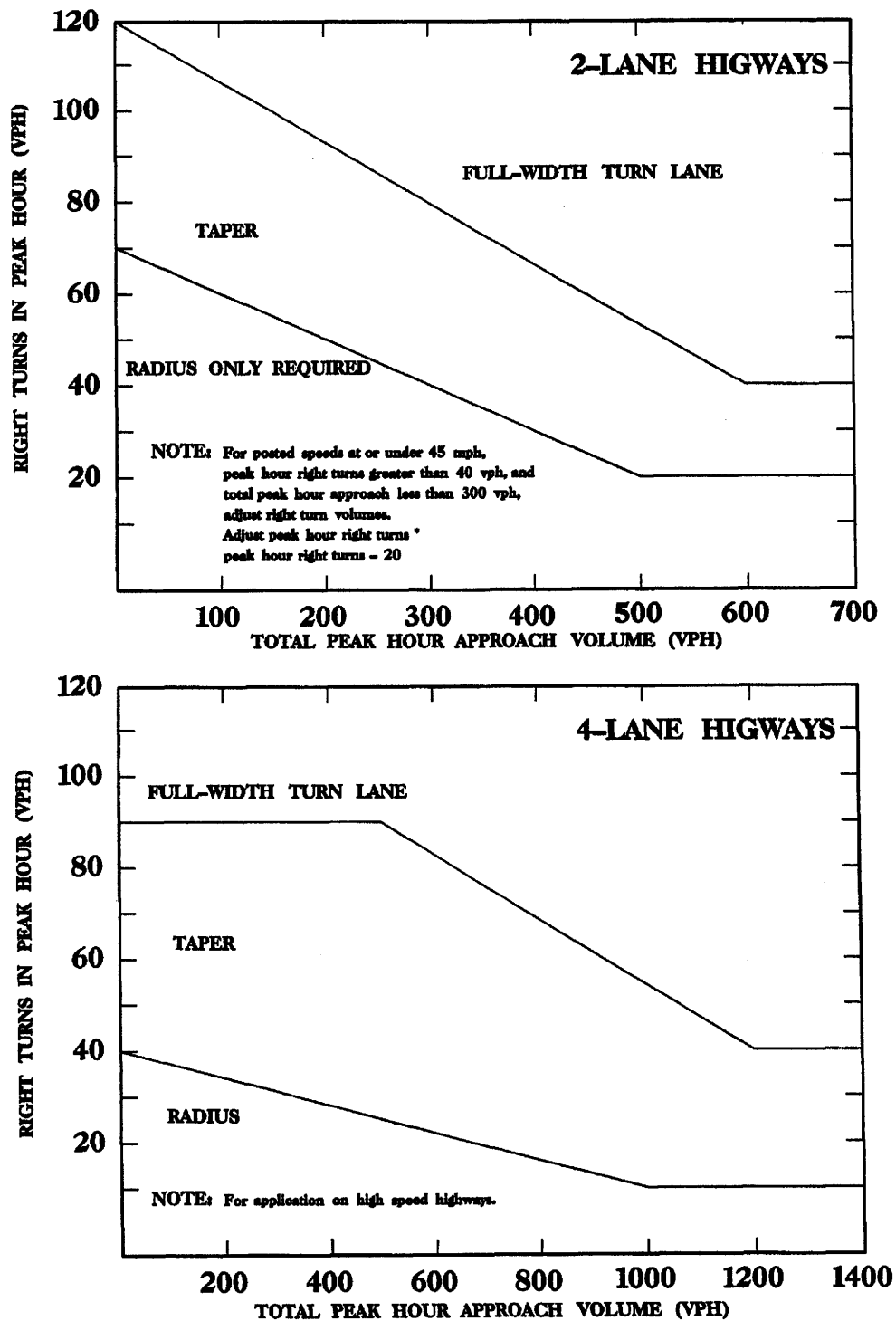
FIGURE 4**9 - 1**
F - 4 B

FIGURE 4

9 - 1
F - 4 C**RIGHT TURN LANE WARRANTS**

THREE CENTERED CURVES

9-2

Three centered curves shall be constructed at locations in accordance with the Policy and Procedure Manual 23/1. The critical dimensions of three centered curves have been worked out for each combination of radii in increments of one degree of angle of turn. These intervals permit a straight line interpolation between the listed values with a maximum error of 0.02' which is within the practical limits of field layout or construction.

Normally, the range in angles of turn permitted for an at-grade intersection is between 60 degrees and 120 degrees. The computations in these tables have been extended to the range of 53 degrees to 128 degrees to provide for those few cases which exceed these normal limits.

When three-centered compound curves are recommended on a project and the design computations are not in the Design Manual, they shall be shown on the plans for the benefit of the Resident Engineer in laying out the curves in the field.

FORCE ACCOUNT ESTIMATES

11-3

Force Account Estimates are only applicable to Federal Aid Projects.

Estimates for force account items will be submitted to the Roadway Design Unit by the Design Review Engineer in Traffic Engineering and Safety Systems. (See The Policy and Procedure Manual, 6/7)

Generally, the following items are covered by force account estimates: signalization, permanent signing, detour signing, and paint striping items.

The Policy and Procedure Manual 18/1, provides information related to Railroad Force Account Items.

COMPUTER ESTIMATES

11-4

All estimates will be entered into Trns*port Estimate Computer Program by the design group responsible for the plans.

FENCE

11-5

CHAIN LINK FENCE

11-5A

(See Roadway Standard Drawing, STD. No. 866.01)

End Brace	- 1 - Terminal Post	1 @ 8' Panels
Line Brace	- 1 - Terminal Post	2 @ 8' Panels
Corner Brace	- 1 - Terminal Post	2 @ 8' Panels

Use end brace on both ends of each section of fence.

Use line brace at 700' intervals on tangents, at 350' intervals on curves, and at breaks less than 30 degrees.

Use corner brace at breaks greater than 30 degrees.

WOVEN WIRE FENCE

11-5B

(See Roadway Standard Drawings, STD. No's. 866.02 and 866.03)

End Brace -	2 @ Posts
	1 @ 8' Panels
Line Brace -	3 @ Posts
	2 @ 8' Panels
Corner Brace -	3 @ Posts
	2 @ 8' Panels

Use end brace on physical ends of fence only.

WOVEN WIRE FENCE (Continued)

11-5B

Use line brace at 300' intervals and at 200' intervals on curves greater than 3 degrees.

Use corner brace at breaks of 15 degrees and greater.

LUMP SUM GRADING

11-6

The following guidelines will be used by the Project Engineer or private engineering firms, to decide whether or not a project will be let on an individual item basis or lump sum grading basis.

Quantities will be prepared in the traditional manner. Once these quantities are known, the following procedures will be used to decide the basis of letting the project:

1. Estimate the quantities for the items and extend prices as follows:

ITEM	QUANTITY PER UNIT	UNIT PRICE	EXTENDED PRICE
CLEARING AND GRUBBING	_____ ACRES	\$ 10,000	\$ _____
UNCLASSIFIED EXCAVATION	_____ YD ³	6.00	_____
BORROW EXCAVATION	_____ YD ³	6.25	_____
SHOULDER BORROW	_____ YD ³	6.25	_____
FINE GRADING	_____ YD ²	2.50	_____
REMOVAL OF EXISTING ASPHALT PAVEMENT	_____ YD ²	2.50	_____
REMOVAL OF EXISTING CONCRETE PAVEMENT	_____ YD ²	10.00	_____
BREAKING OF EXISTING ASPHALT PAVEMENT	_____ YD ²	2.00	_____
BREAKING OF EXISTING CONCRETE PAVEMENT	_____ YD ²	5.00	_____
TOTAL		\$	_____

LUMP SUM GRADING (Continued)

11-6

2. If the summation of the item amounts is \$1,000,000.00 or less, then the grading may be let on a "lump sum" basis with concurrence of the Division Engineer. If the cost of any one of the items, excluding clearing and grubbing and fine grading, is 50% or more of the total cost calculated, then that item shall be included as an individual item with the other items being done on a "Lump Sum Grading" basis. A special provision will be needed in this case and the pay item "Grading" should be indicated as a "sp" in the estimate. If the sum of the item amounts exceeds \$1,000,000.00 or is 25% or more of the total cost of the project, the project shall contain the individual items in accordance with the Standard Specifications.
3. Other considerations for lump sum grading may utilize a dollar limit. For example, 3R Projects with "Trenching & Widening" and minor grading should be considered when use of cross-sections for earthwork by the Resident Engineer is not practical. When applying lump sum grading to these special applications, approval by the Assistant State Roadway Design Engineer and Proposals and Contracts Section Engineer is required on a project-by-project basis.

The net result of this method of letting the grading should result in less construction engineering manpower for the applicable projects.

See Part II, Chapter 19, Section 19-5 for the "Lump Sum Grading Note".

PAVEMENT SCHEDULE (continued)

6-1D

Letter-number combinations shall be used to designate different items having the same code letter and to designate different thickness of the same material.

Descriptions of the various elements shall show thickness, size, rate of application and maximum and minimum thickness per application or layer as applicable. Questions related to pavement design details shall be referred to the Pavement Design Engineer in the Pavement Management Unit.

See 6-ID, Figure 1 for sample pavement schedule.

OPTIONS ITEM LIST

For assembling a pavement schedule, see 6-ID, Figure 1 for an example. The pavement schedule is assembled by utilizing a CADD System. This expanded option items list is plotted by CADD management. Descriptions can be deleted or corrected as needed.

Mix Type	English(Inches)		
	Minimum lift	Maximum lift	Maximum total layer
SF9.5A	1.0	2.0	3.0
S9.5X	1.5	2.0	3.0
S12.5X	2.0	2.0	4.0
I19.0X	2.5	4.0	4.0
B25.0X	3.0*	5.5	-

* For B25.0X placed on unstabilized subgrade, minimum lift thickness is 4.0.

PAVEMENT SCHEDULE (continued)

6-1D

The % and type of Asphalt Binder and rate to be used for calculation of quantities are as follows:

Mix Type	% Asphalt Binder	Asphalt Binder Grade	Rate Lbs/SY/in
<u>FRICITION</u>			
OGAFC, TYPE FC-1	6.3	PG 64-22	75 Lbs/SY
OGAFC, TYPE FC-1 MODIFIED	6.3	PG 76-22	75 Lbs/SY
OGAFC, TYPE FC-2 MODIFIED	6.0	PG 76-22	90 Lbs/SY
<u>Surface</u>			
S4.75A	7.0	PG 64-22	100
SF9.5A	6.5	PG 64-22	110
S9.5B	6.0	PG 64-22	112
S9.5C	6.0	PG 70-22	112
S12.5C	5.5	PG 70-22	112
S12.5D	4.8	PG 76-22	112
<u>Intermediate</u>			
I19.0B	4.7	PG 64-22	114
I19.0C	4.7	PG 64-22	114
I19.0D	4.7	PG 70-22	114
<u>Base</u>			
B25.0B	4.3	PG 64-22	114
B25.0C	4.3	PG 64-22	114
B37.5C	4.3	PG 64-22	114
PADC, TYPE P-57	2.0	PG 64-22	90
PADC, TYPE P-78M	3.0	PG 64-22	90

NOTE: It is suggested that like pavement mixtures be grouped together in the Pavement Schedule.

PAVEMENT SCHEDULE(continued)		6-ID
CODE	SAMPLE	DESCRIPTION
		F-1

A1 9" Portland Cement Concrete Pavement

A2 8" Continuously Reinforced Concrete Pavement

B Prop. Approx. _____" Open-Graded Asphalt Friction Course, Type FC_____, at an Average Rate of _____ lbs. per sq. yd.

For Surface Course

C1 Prop. Approx. _____" Asphalt Concrete Surface Course, Type S_____, at an Average Rate of _____ lbs. per sq. yard.

C2 Prop. Approx. _____" Asphalt Concrete Surface Course, Type S_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

C3 Prop. Var. Depth Asphalt Concrete Surface Course, Type S_____, at an Average Rate of _____ lbs. per sq. yard per 1" depth to be placed in layers not to exceed _____" in depth.

For Intermediate Course

D1 Prop. Approx. _____" Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of _____ lbs. per sq. yard.

D2 Prop. Approx. _____" Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

D3 Prop. Var. Depth Asphalt Concrete Intermediate Course, Type I19.0_____, at an Average Rate of 114 lbs. per sq. yard per 1" depth to be placed in layers not less than 2 1/2" or greater than 4" in depth.

For Base Course

E1 Prop. Approx. _____" Asphalt Concrete Base Course, Type B_____, at an Average Rate of _____ lbs. per sq. yard.

E2 Prop. Approx. _____" Asphalt Concrete Base Course, Type B_____, at an Average Rate of _____ lbs. per sq. yard in each of two layers.

PAVEMENT SCHEDULE (continued)

6-1D

F-1

- E3 Prop. Var. Depth Asphalt Concrete Base Course, Type B_____, at an Average Rate of 114lbs. per sq. yd. per 1" depth, to be placed in layers not greater than _____" in depth or less than _____" in depth.
- F1 Asphalt Surface Treatment, Mat and Seal.
- F2 Asphalt Surface Treatment, _____
- G Prop. Approx. 8" Cement Treated Base Course (Plant Mixed)
or
Prop. 8" ABC with the top 7" to be Cement Treated (Road Mixed).
- J1 Prop. 8" Aggregate Base Course
- J2 Prop. 10" Aggregate Base Course
- J3 Prop. Var. Depth Aggregate Base Course
- K Base to be treated with Lime to a depth of 8", at a rate of 20 lbs. per. sq. yd. as directed by the Engineer.
or
Base to be treated with cement to a depth of 7", at a rate of 55 lbs. per. sq. yd. as directed by the Engineer.
or
Base to be treated with aggregate at a rate of 250 lbs. per. sq. yd. and cement at a rate of 55 lbs. per. Sq. yd. to a depth of 7" as directed by the Engineer.
- L Base to be stabilized with 200 to 400 lbs. per sq. yard of Stabilizer Aggregate mixed with the top 3" of subgrade soil at locations directed by the Engineer.
- M1 Prop. 8" Soil Type Base Course, Type A
- M2 Prop. 10" Soil Type Base Course, Type _____
- P1 Prime Coat at the rate of .35 gal. per sq. yard.
- P2 Prime Coat at the rate of .50 gal. per sq. yard.
- R1 2'-6" Concrete Curb and gutter
- R2 1'-6" Concrete Curb and Gutter

FINAL PLAN PREPARATION (FUNCTION CODE 208)

Coordinate with the right of way agents as necessary to make needed right of way plan revisions.

Coordinate as required with the Structure Design Unit, Traffic Engineering Branch, Design Services Unit, the Geotechnical Unit, the Division, and the Roadside Environmental Unit to obtain their recommendations.

Receive the final pavement design and incorporate and finalize typical sections.

Schedule a final field inspection, distribute plans and memorandums to all involved personnel.

Incorporate comment from the field inspection as well as other units.

Compute contract quantities.

Complete the final plans checklist to ensure accuracy and completeness of the plans.

Correct all errors on plans and review plans sent in by other units for conformance.

Complete the formal summaries to be placed within the plans such as Earthwork Summary, Guardrail Summary and Pavement Removal Summary.

Note applicable General Notes, standards and any needed special provisions.

Complete the response to the Division Engineer and explain why certain Division recommendations were not included within the plans.

Upon receipt of environmental permits, review the permits to ensure permit conditions have been met and the permit is in conformance with the design.

Compile a list of final quantities and prepare an estimate.

Compile the project file; purge any unnecessary or trivial data from the files.

PROJECT FILE CONTENT

Required content for files submitted with final plans to the Contract Office, at the specified flow chart date, is contained in bound files and loose files.

The Bound File (Brown Folder) should include information as follows:

1. All approvals and denials.
2. Field inspection correspondence.
3. Information related to any pending actions.
4. Correspondence providing historical or background information on controversial matters.
5. Justification studies for special or unusual matters.
6. Correspondence originated in the Highway Design Branch.
7. Correspondence in which the Highway Design Branch was the primary recipient.
8. Geology recommendations.
9. Structure recommendations.
10. Any other items that in the judgement of the Project Engineer should be retained.

The loose file (Manila Folder) should contain information as follows:

1. Review list for final construction plans (Complete each requirement on the list prior to indicating it complete with a check mark).
2. Completed check list for coordination of Roadway and Structure plans.
3. Estimates.
 - A. Latest Roadway Computer Estimate.
 - B. Estimates from other units.
 - C. Cost Based Estimates Quantity Breakdown Summary Sheet.
 - D. Force Account Estimates.
4. Earthwork Summary Worksheet.
5. Earthwork Computations
6. Calculation of Quantities Package.
7. List of Roadway Standard Drawings.
8. General Notes.
9. Special Provisions.
10. The XY_Coord. CSV electronic File generated by the "Centerline coordinate list" procedure.

Materials and/or correspondence that should be removed is as follows:

1. Preliminary Designs.
 - A. Drawings.
 - B. Estimates.
 - C. Calculations.
2. Subsurface investigations and reports (These are included in the Subsurface Plans).
3. Transmittal slips and/or memorandum forms (except the last one) and right-of-way revision memorandums.
4. All Duplications.
5. All Engineers Estimates except the latest printout.

Please label file tabs with the Project Construction number, T.I.P. number and County.

Submit the plans to the Plans Review Section in the Design Services Unit.

Receive and incorporate comments from the Plans Review Section.

Once the project is sent to the Proposals and Contract Section, answer any questions that may arise.

Project is advertised for bid; project is let and then awarded.

Make any necessary construction revisions and charge these revisions to function code 264.

